

WH-11 16-Bit Digital
Computer System

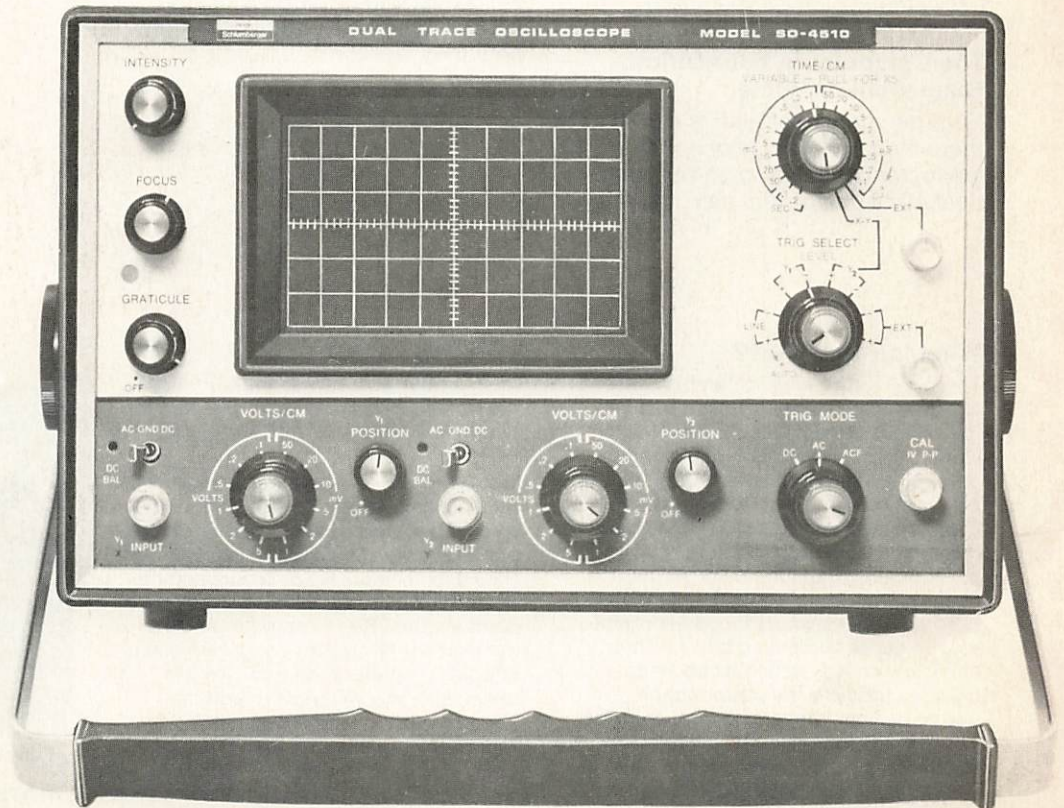
WH-17
Floppy Disk

Heath/Schlumberger Instruments

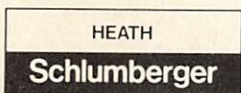
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SO-4510 Dual Trace Oscilloscope



Welcome To Personal Computing

A brief introduction to personal computing for you, your business or your classroom and the full line of computers and peripherals from Heath/Schlumberger

An Exciting New Hobby

Personal computing is the use of low cost microcomputer systems in offices, small businesses and schools as well as for hobby and leisure time activities. It's one of the most exciting and interesting new electronic developments to come along in some time. And it's an activity that can provide you with information handling capabilities that are limited only by the scope of your imagination and are broadened by the technology of tomorrow. Why not give it a try? Computers aren't mysterious, they're simply tools, and you can learn to use them much more easily than you ever imagined.

The Computer In Your Office, Classroom or Home.

Your personal computer is much more than just a piece of hobby equipment. It can also be very practical. It's a device that can not only

give you uncounted hours of after-hours recreation but can also manage a wide variety of data processing, storage and retrieval applications on the job or in the classroom. Program it to maintain your checkbook, keep track of inventory, teach or whatever. Use it for a while and you'll find hundreds of practical applications for it!

A Learning Experience

Owning and using a personal computer is a real learning experience. You'll learn to solve problems, to program, and you'll learn how computers work. Because, let's face it, computers are used everywhere and their application is becoming even more widespread as low cost mini and micro computers are incorporated into many new devices. And because computers are so widely used in all aspects of your profession today — it pays to know how they work!

Let Us Get You Started

Heath/Schlumberger has everything you'll need to get started in personal computing. Our complete line includes two computers, three peripherals, and all of the software to make them work together. Even if you don't know anything about computers, our world famous documentation will make your introduction quick and easy. And when you're ready to start programming, our low cost BASIC programming course (pg. 30) will guide you every step of the way. So welcome to personal computing and welcome to computer products by Heath/Schlumberger.

The Heath/DEC WH-11 Computer

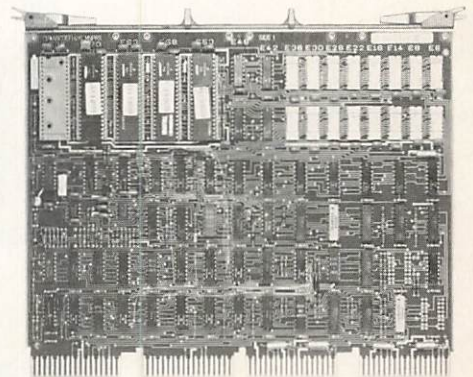
What Is The WH-11?

The WH-11 is Heath/Schlumberger's top-of-the-line computer designed for the serious personal computer. It is the world's most powerful personal computer offering the advanced user the power and potential to implement more sophisticated applications. Most users discover that their problem solving and programming capabilities grow quickly as they learn more about the computer. Before long, many advanced users simply run out of computing power. Their small low cost system may be inadequate to produce the performance required by some advanced applications. The WH-11 is the computer that meets the demand for superior performance in hobby, small business and educational applications. When you buy the WH-11 you buy virtually unlimited potential.

The Heath/Schlumberger WH-11 is virtually identical to DEC's famous PDP-11/03 microcomputer. In addition, complete software is supplied with the WH-11. This software is worth over

\$1,000 when purchased separately for the DEC PDP 11/03. The WH-11 is clearly a spectacular hardware/software value.

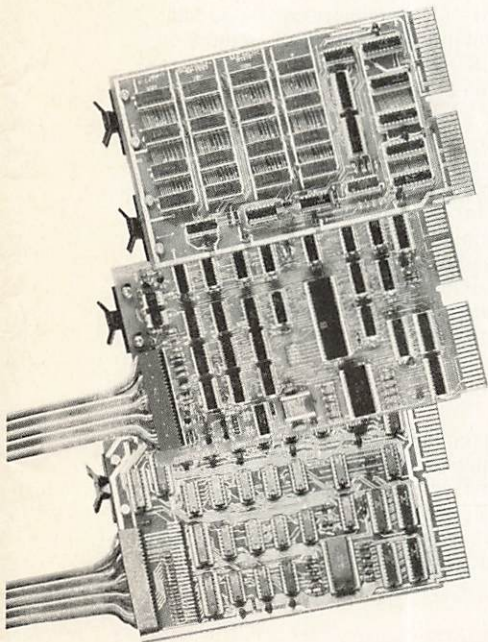
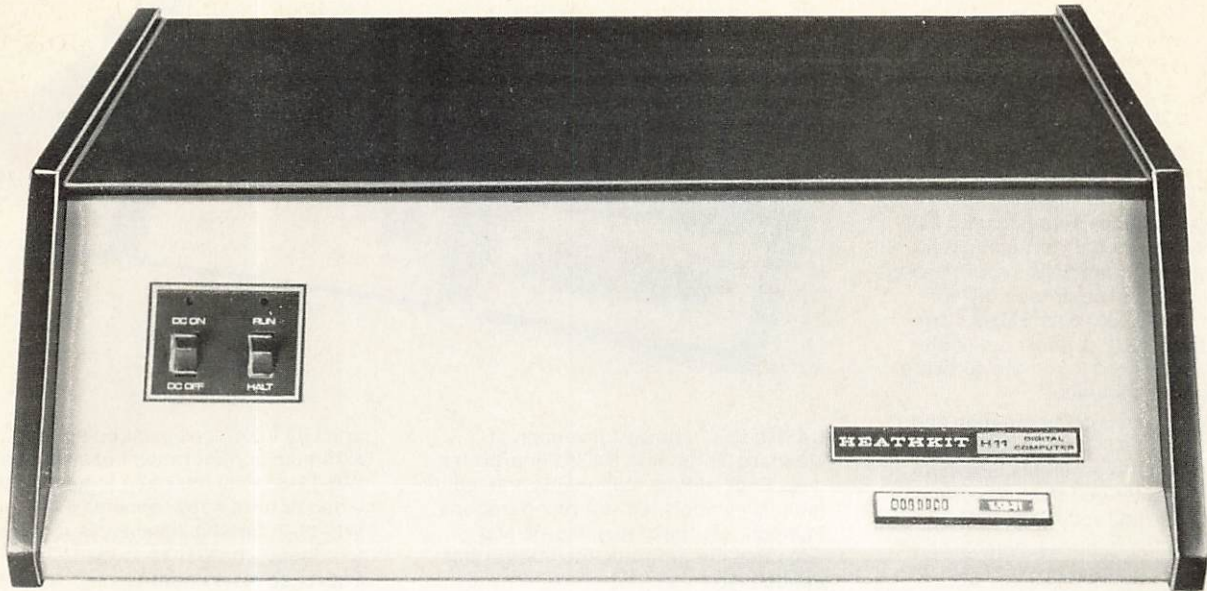
The basic WH-11 computer is supplied fully-assembled and tested with an attractively styled cabinet, a heavy-duty power supply, a backplane incorporating DEC's famous LSI-11 or Q-Bus and the powerful KD11F CPU board. This board contains the LSI-11 computer and 4K dynamic RAM. Systems software is also supplied in paper tape form. To this mainframe you will need to add the various memory and I/O accessories that will configure your WH-11 to your specifications. The WH-11 backplane, with the KD11-F board in place, contains 6 plug-in slots for memory and I/O cards (described on the following pages). Rugged metal cabinet with high impact plastic sides measures 19" W x 6½" H x 17" D. For 110/220 VAC, 50/60 Hz.
811-26/WH-11, Factory Assembled and tested 43 lbs. \$1595.00



Fully Assembled and tested KD11-F board

NOTE: DEC, DIGITAL, FOCAL AND PDP ARE REGISTERED TRADEMARKS OF DIGITAL EQUIPMENT CORPORATION.

WH-11 Memory And I/O Accessories



WH-11-1 4K Memory Expansion Module: Plugs into WH-11 backplane, adds 4K x 16-bit word capacity to WH-11 memory. Uses high-reliability 1K x 4 static MOS RAM chips. Access time is less than 500 nS. Has decode circuitry for operation on 4K address boundaries. Handle for easy removal and insertion.
811-26/WH-11-1, 1 lb. \$275.00

WH-11-2 Parallel Interface. General purpose parallel interface featuring 16 diode-clamped latched data input lines, 16 latched output lines, 16-bit word or 8-bit byte data transfers. The WH-11-2 also has LSI-11 bus interface

and control logic for interrupt processing and vectored addressing; control status registers compatible with PDP-11 software routines. Four control lines for output data ready, output data accepted, input data ready and input data accepted logic operations. Maximum data transfer rate, 90K words per second under program control. Maximum drive capability, 25-ft. cable.
 The WH-11-2 is required for interfacing the WH-11 to the H-10 Paper Tape Reader/Punch.
811-26/WH-11-2, 1 lb. \$150.00

WH-11-5 Serial Interface: Universal asynchronous receiver/transmitter serial interface module for use between LSI-11 bus and serial devices such as the Heathkit WH9 video terminal or LA36 teleprinter. Has optically isolated 20 mA current loop and EIA interfaces; selectable baud rates of 50 to 9600. With all mating connectors.
811-26/WH-11-5, 1 lb. \$150.00

H-11-6 Extended Arithmetic Chip: Adds powerful arithmetic instructions to the LSI-11, including fixed point multiply, divide and extended shifts plus full floating point add, subtract, multiply and divide. Helps minimize or eliminate arithmetic sub-routines and speeds up program execution. IC package plugs into socket on WH-11 CPU board.
811-26/H-11-6, wt. 1 lb. \$159.00
NOTE: DEC, DIGITAL, FOCAL AND PDP ARE REGISTERED TRADEMARKS OF DIGITAL EQUIPMENT CORPORATION.

HEATH/DEC Software License Agreement:
This form MUST accompany your H11 computer order.

CUSTOMER SUBLICENSE GRANT
 HEATH COMPANY (hereinafter referred to as HEATH) pursuant to a license agreement with Digital Equipment Corporation (hereinafter referred to as DIGITAL) does hereby grant to CUSTOMER a non-transferable and non-exclusive sublicense to use the Binary Software Program(s) PTSP-11 Paper Tape System, FOCAL/PTS Language Processor, BASIC/PTS Language Processor (hereinafter singularly and/or collectively referred to as "Software") on the following terms and conditions.
 Software is furnished to CUSTOMER for use on a single CPU only and may be modified, or copied (with the inclusion of DIGITAL's copyright notice) only for use on such CPU. The CUSTOMER shall not provide or otherwise make available the Software or any portion thereof in any form to any third party without the prior approval of DIGITAL. Title to the ownership of the Software shall at all times remain with DIGITAL.

HEATH
Schlumberger

Powerful Heath/DEC PDP-11 Software at no Extra Cost!



The WH-11 includes sophisticated software that lets you get your computer up and running with practical programming capabilities. This paper tape based software would cost over \$1200 if purchased separately. A minimum of 8K memory is required to run the software. The programs include:

ED-11. Assists you in the creation and modification of ASC11 source tapes, also used to write assembly language programs and for general text editing or word processing functions.

PAL-11S. Relocatable assembler converts ASC11 source tapes into relocatable binary modules. This lets you create programs in small, modular segments for easier coding and debugging. These binary modules serve as inputs to LINK-11S.

LINK-11S. Link editor which links the modules created by the PAL-11S into a load module ready for execution on the WH-11. The module is loaded into the WH-11 via the Absolute Loader.

Absolute Loader. Loads absolute binary tapes into the WH-11 memory for execution.

ODT-11X. Lets you debug the programs which you have created. Permits modifying and controlling program execution "on the fly" for quick, efficient debugging.

IOX. I/O executive program permits I/O programming without developing device-driving programs. Links to your programs using the LINK-11S. For use with high speed paper tape reader/punch and line printer.

DUMP-AB and DUMP-R. Lets you dump absolute binary contents of memory to the paper tape punch.

BASIC. DEC's powerful version of standard Dartmouth BASIC interpreter uses English-type statements and mathematical symbols to perform operations. Immediately translates, stores and executes the program. Includes string capability.

FOCAL. DEC's own interpretive computer language which combines simplicity with computing power. Ideal for most scientific, engineering and math applications. FOCAL programs can be written and executed easily. Both 4K and 8K versions are included.

Configuring Your WH-11 System

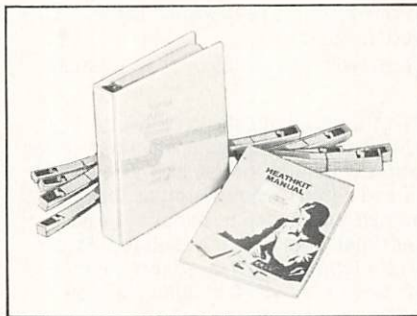
The basic WH-11 mainframe contains CPU, 4K of memory and power supply. To use the WH-11, additional memory

and I/O interfaces must be added. The minimum configuration consists of a WH-11-5 serial interface to an external video or hard copy terminal. The WH-11-2 parallel interface is required to connect the WH-11 to the H-10 Paper Tape Reader/Punch. These two interface cards occupy two of the available 6 slots in the back plane. This leaves four additional slots for memory expansion. Using the WH-11-1 4K memory card, 16K of memory can be added. Combined with the 4K of memory on the KD-11F board, this permits a maximum of 20K (16-bit word) of RAM.

The minimum amount of memory required by the WH-11 is 4K. With 4K of memory you can write simple programs in machine language. The FOCAL interpreter also runs in 4K. To run the other computer software, including BASIC, assembler, editor and others, at least 8K of memory is required. 12K to 16K memory is recommended depending upon your applications.

Buy a complete WH-11 system and SAVE!

You can choose a complete computer system consisting of the WH-11 computer, one major peripheral, plus memory and accessories, and deduct 5% from the total price (excluding shipping and handling charges).



Coming Soon: WH-27, the WH-11 Floppy Disk System!

Featuring complete compatibility with the WH-11 as well as DEC's PDP 11/03 and other LSI-11 based systems, Heath/Schlumberger's WH-27 features both single and dual-drive versions.

Included with the WH-27 package is a controller/interface card with ROM boot loader (which plugs directly into the WH-11 backplane) and the complete WH-11 operating systems software including: HDOS, BASIC, FOCAL, and executive with file handling capability.

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HEATH COMPANY

By _____

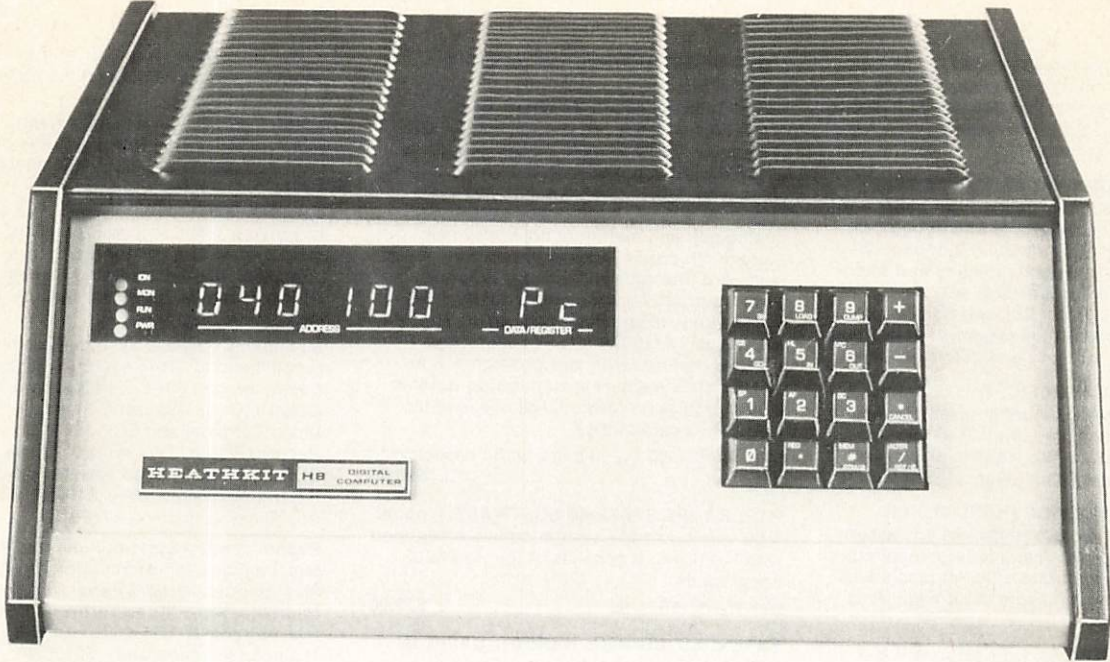
William F. Johnson

CUSTOMER

By _____

Customer's Signature

A Totally-Unique 8-Bit Computer



The WH-8 Computer is the ideal choice for personal computing, particularly for learning. It is low in cost and simple to operate. And while it is an ideal entry level machine, it provides the expansion capability that allows you to build it into a very powerful and capable general purpose digital computer system. The WH-8 lets you start small and increase its power and versatility as you increase your programming expertise.

The WH-8, with the addition of 4K of memory, makes an ideal computer trainer. Its 16-key front panel keyboard provides octal data entry and allows direct access to registers and memory, one-button program load and dump and input/output keys for direct communication with any port. Its 9-digit octal readout provides far more information than conventional computers—memory, registers and I/O port displays are continuously updated even while programs are running for direct monitoring of program activity. You can select the register or memory location you would like to see and monitor it as the program is being executed. And by adding more memory, the WH-8 becomes more powerful to accommodate the more complex programs you will learn to write. And because it is based on the popular 8080A CPU, it can become immediately practical with the large quantity of software already available.

The WH-8 includes complete systems software in 1200 baud audio cassette form to get you up and running fast. A complete description of this software is on the next page. Other WH-8 features include: our exclusive 50-pin fully-buffered bus designed for better bus integrity and arranged for convection cooling; mother board with positions for up to 9 plug-in circuit boards that accept

the CPU, front panel memory, I/O and other accessory cards; built-in convection-cooled power supply; built-in speaker for audible feedback and special effects; front panel status lights and more. The WH-8 is housed in a rugged metal cabinet with structural foam side panels. 16¼" W x 6½" H x 17" D. Switch-selected 120/240 VAC 50/60 Hz. Requires at least one H8-1 memory board to operate.

811-26/WH-8, Fully Assembled and Tested, 30 lbs. \$475.00

Memory and I/O Accessories: The WH-8 requires at least 4K of optional memory. It communicates with a terminal or mass storage device with an interface (I/O) device. Listed below are available memory and I/O accessories for the WH-8.

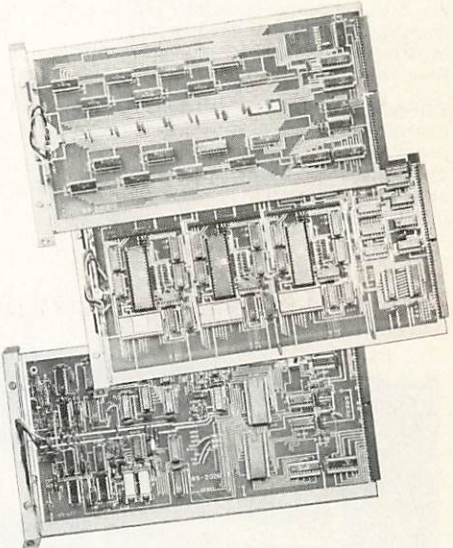
WH-8-8 Memory Board. 8Kx8 memory card supplied with 8K memory, plugs directly into WH-8 bus. Features maximum storage capacity of 8192 8-bit words. Uses modern 4Kx1 static memory IC chips. Access time, less than 450 nS. With on-board regulators, heat sinks and full buffering.

811-26/WH-8-8. Wt. 2 lbs. \$250.00

H-8-2 Parallel Interface Kit. Connects WH-8 to any parallel device such as a paper tape reader/punch (required for H-10). Three independent parallel ports (8 bits input and 8 bits output ea.) and universal handshaking capability. Compatible with all Heath software. 390 mS (max) transfer time.

811-26/H-8-2. Wt. 3 lbs. \$150.00 Kit

WH-8-5 Serial I/O and Cassette Interface. Connects the WH-8 to serial devices such as the WH-9 video terminal or the H-36 DEC Writer II. Selectable data rate from 110 to 9600 baud and common input/output interfaces includ-



ing 20 mA current loop and EIA RS-232C compatible levels. Cassette recorder interface permits use of the ECP-3801 (see p. 29). Uses the popular Byte/Manchester recording format but runs at 1200 baud. Has control lines for remote start and stop of two cassette units to allow separate record and playback capability. Fully compatible with all Heath software.

811-26/WH-8-5. Wt. 2 lbs. \$150.00

NOTE: Proper operation of the WH-8-5 is assured only if you use the ECP-3801 cassette player/recorder and Heath/Schlumberger-recommended recording tape (ECP-3802, page 29). Heath/Schlumberger is not responsible for improper operation associated with other cassette units.

Software: The Heart of your WH-8 System

WH-8 Software: Complete systems software is supplied with the WH-8 computer at no additional cost so that you can use your system immediately. Software supplied with the WH-8 computer includes:

PANEL MONITOR (PAM-8). This 1K ROM program monitor controls the front panel and permits you to load, execute and debug programs written in 8080 machine language. It provides memory contents display and alteration, register contents display and alteration, program execution control, self-contained bootstraps for one-button program loading and dumping, and port input and output routines.

BENTON HARBOR BASIC. This conversational programming language uses simple English statements and familiar algebraic equations to perform operations and solve problems. Requires a minimum of 8K memory.

ASSEMBLY LANGUAGE (HASL-8). This two-pass absolute assembler lets you assemble source programs using letters, numbers and symbols to generate efficient machine language code. A minimum of 8K memory is required.

TEXT EDITOR (TED-8). Converts the WH-8 computer and terminal into a powerful typewriter for generating text and editing. It prepares the source code for WH-8 assembly language, and can be used to prepare reports, write letters and edit manuscripts. Requires a minimum of 8K memory.

CONSOLE DEBUGGER (BUG-8). This enhanced and extended version of the front panel monitor allows entry and debugging of user machine language programs via an external terminal. It requires 3K memory plus user program.

The following software is optional at extra cost:

EXTENDED BENTON HARBOR BASIC WITH FILES. Extended Benton Harbor BASIC is an enhanced and more powerful version of the BASIC supplied with the WH-8. It provides even faster operation and includes character strings, additional convenience commands and math functions, dynamic storage allocation, access to real time clock, keyboard interrupt processing, expanded error messages and recovery ability, LED display control and key pad support. Complete files capability lets you store and retrieve data records and programs. Minimum of 12K memory is required to run this BASIC, 16K is preferred if full use is to be made of its capabilities.

811-26/HCB-13 (1200 baud audio cassette)
1 lb.\$20.00

PAPER TAPE SYSTEMS SOFTWARE. A paper tape version of the system software supplied with the WH-8. It consists of four fan fold paper tapes.

811-26/H8-15, 1 lb.\$20.00

EXTENDED BENTON HARBOR BASIC IN PAPER TAPE form similar to HCB-13 above but without files.

811-26/H8-14, 1 lb.\$10.00

How to Configure Your WH-8 System

Because of the great flexibility of the WH-8 and its ease of expansion, there are many ways to configure it. Start with the WH-8 and a single 8K memory card (WH-8-8) to give you the minimum workable system. Or, purchase the WH-8 fully expanded complete with four 8K cards (WH-8-8) and a variety

of I/O interfaces. The following are the most popular configurations and the ones of most value to you.

8080A Trainer. The simplest WH-8 computer configuration is the WH-8 mainframe plus a single 8K memory card WH-8-8. Because the WH-8 front panel is in itself the complete input/output device, you can begin using your WH-8 immediately. This minimum system is great for learning machine language programming and makes an ideal microprocessor trainer for schools or self instruction.

Minimum Complete System. The minimum recommended WH-8 system includes WH-8 computer, one WH-8-8 8K Memory, WH-8-5 Serial I/O and Cassette Interface, WH-9 Video Terminal and ECP-3801 Cassette Record/Player. This system allows you to use all of the supplied system software. If purchased separately, \$1610.00. Special system price, \$1529.50.

Recommended System. A deluxe WH-8 system, includes WH-8 computer, three WH-8-8 8K Memories, WH-8-5 Serial I/O and Cassette Interface, WH-9 Video Terminal, WH-17 Floppy with optional H-17-1 drive and H-8-17 software. If purchased separately, \$3120.00. Special system price, \$2873.75.

Buy a complete computer system and SAVE!

Choose a complete computer system consisting of the WH-8 computer, one major peripheral, plus memory and accessories, and deduct 5% from the purchase price (excluding shipping and handling charges.) Choose one of the Heath-recommended systems above (which already have the discount calculated for you), or "roll your own" with system components you select!

The New Systems-Engineered WH-17 Floppy



Shown with
Optional Second Drive

The new WH-17 Floppy is a versatile, high-speed, mass storage peripheral—at a price that's truly affordable. Designed exclusively for use with the WH-8, the WH-17 has been "systems" engineered to encompass a complete package (including disk drive, interface/disk controller circuit board, and built-in power supply). With the inclusion of an optional second drive it gives its user

the added versatility offered only in a dual-drive system! NOTE: The WH-8 must have 16K of RAM to use WH-17 and operating system. Storage media for the WH-17 consists of the extended, hard-sectored, 40-track diskette. Measuring just 5.25" in diameter, each diskette offers the user access to 400 sectors (10 per track) or better than 102K Bytes of available program and data storage area!

Because reliability and accurate high-speed data access were first design priorities, the WANGCO model 82 drive was selected. The model 82 drive posts a conservative 30 millisecond track seek specification and typical random sector access times of less than 250 milliseconds.

The H-8-17 is the operating system software for the WH-8/WH-17 system. This software includes the Heath Disk Operating System (HDOS), with its unique diagnostic for unit evaluation and optimization. Additional utilities operate like BUG-8, a console debugger; TED-8, our powerful text editor; HASL-8; and extended Benton Harbor BASIC so all your existing programs will be upward compatible. An extra diskette is included. BASCON and TXTCON allow tape BASIC programs and TED-8 programs to be converted to disk easily. (Note: if using a single drive WH-17, the WH-8's operating systems will occupy 60 of the 400 disk sectors. However,

811-26/WH-17, 28 lbs.\$675.00

811-26/H-17-1, Optional Second Drive,
4 lbs.\$295.00

811-26/H-17-2, Diskette, Pkg. of 5
1 lb.\$25.00

811-26/H-8-17, Software, 5 lbs.\$100.00

811-26/WHS-170, Single Drive Combo—
SAVE \$80. Includes WH-17 and H-8-17,
33 lbs.\$695.00

811-26/WHS-171, Dual Drive Combo—
SAVE \$95. Includes WH-17, H-17-1
and H-8-17, 37 lbs.\$975.00

Peripherals for WH8 and WH11 Computers

WH9 Video Terminal with 12" CRT Display

The WH9 video terminal is a general-purpose peripheral designed for use with the Heathkit WH8 or WH11 computers. It provides keyboard input and a CRT for the convenient entry and display of computer programs and data. It can be used with any computer in stand-alone applications or in time-sharing systems.

Character format is standard upper case 5x7 dot matrix. The long form display is twelve 80-character lines. The short form display is forty-eight 20-character lines in four 12-line columns. An automatic line carry over feature executes line feed and return when line exceeds character count on both long and short-form displays. A built-in oscillator/speaker generates a 4800 Hz tone and serves as audible end-of-line warning.

Auto-Scrolling is featured in both long and short-form. In the long form, as the line enters at bottom, the top line scrolls off screen; in the short

form, as the column enters from the right, the left column scrolls off screen. Auto-scrolling can be defeated with a front panel switch. The cursor mark indicates the next character to be typed for accurate positioning. Cursor controls include up, down, left, right and home. Serial data baud rates are selectable from 110-9600. Baud rate clock output and reader control are available on the rear panel connector.

The **erase mode** permits automatic full page erase or erase to end of line starting at cursor position. A transmit page function allows a full page to be formatted, edited and modified, then transmitted as continuous data.

The **plot mode** permits graphs, curves and simple figures to be displayed. Plotting can be accomplished via the front panel keyboard or from external inputs.

The **WH9 serial interface** provides EIA RS-232C levels, a 20 mA current loop and standard TTL levels. Parallel interfacing includes standard TTL levels, 8 bits input and 8 bits output and 4 handshaking lines for connection to WH10.

Ultra-compact size, only 12½" H x 15½" W x 20¾" D, makes the H9 ideal for desktop or console applications. For 110 VAC, 60 Hz or 230 VAC, 50 Hz.

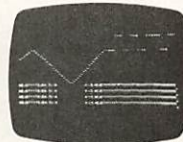
811-26/WH9, Shpg. wt. 50 lbs. \$675.00



Long Form



Short Form



Plot Mode

H-10 Paper Tape Reader/Punch Kit

The H-10 paper-tape reader/punch is a general-purpose mass storage peripheral using reliable low-cost paper tape. It's fully compatible and styled to match the WH8 and WH11 computers, and it works reliably with any other computer through a parallel interface. The H-10 uses standard 1" wide roll or fan-fold 8-level paper tape. Standard punched paper tape gives you the reliability, durability and trouble-free handling you need for effective mass-storage of programs and data.

The **reader** reads tape up to a maximum rate of 50 characters per second. A full sensitivity adjustment on each channel permits any color, thickness, quality (oiled or unoled) paper tape to be used. Sensitive Darlington photo transistors and an incandescent lamp reader head provide reliable reading. The powerful stepper motor drive insures accurate tape positioning and movement.

The **punch** operates up to maximum speed of 10 characters per second. Ratchet/solenoid drive and solenoid control of punches provide accurate and consistent punching.

Controls include power on-off, read and punch start. A feed control feeds blank tape through the punch for leader tape, a copy control provides fast, easy tape duplication.

Interfacing is provided by separate 8-bit parallel input and output buses with standard TTL logic levels and handshaking lines for both reader and punch. A rear panel 24-pin connector and mating cable are supplied.

Accessories include holder for roll paper tape, chad collector tray and collector box for fan-fold tape, 8" roll 900 ft. blank paper tape. Cabinet with metal top and steel chassis. 12½" H x 9¾" W x 19½" D. For 110-130 VAC, 60 Hz or 220-240 VAC, 50 Hz.

811-26/H-10, Kit, Shpg. wt. 29 lbs. . . \$595.00

Three Rolls Blank Paper Tape, each 8" diameter, 900-ft. min.

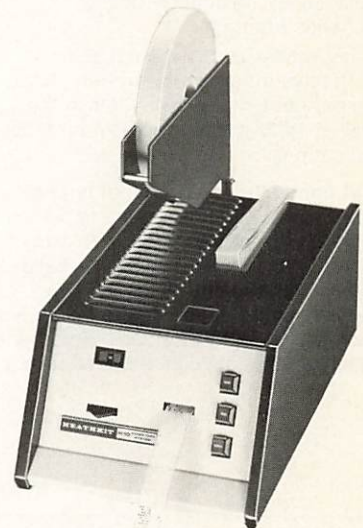
811-26/H10-2, Shpg. wt. 5 lbs. \$10.00

Three Boxes Fan-Fold Tape. Approx. 1000-ft. each.

811-26/H10-3, Shpg. wt. 5 lbs. \$15.00

This is the famous advanced technology teleprinter offering true 30-cps throughput, variable-width forms handling, 128-character upper/lower case set and extra-quiet operation. It features a 7x7 dot matrix print head, adjustable left and right hand tractors for precise margin positioning; half or full duplex operation; ANSI standard multi-key rollover and a typewriter-like keyboard. Handles up to 6-part forms with a .020" maximum pack thickness. Print format is 132-column, with 10 characters per inch horizontal spacing and 6 lines per inch vertical spacing. Print speed is switch selectable 10, 15 or 30 cps. The H36 is compatible with both the WH8 and WH11 computers, as well as most other hobby and personal computers. Operates on 90-132 VAC, 60 Hz (220 VAC, 50 Hz version available). Overall size, 27½" W x 33¼" H x 24" D.

The H36 (LA36 DEC WRITER II) is shipped Motor Freight, prepaid to your nearest terminal within the Continental U.S. Include your



LA36 DEC Writer II Printer Terminal



phone number on order for notification of arrival. Arrangements for home delivery may be made at no extra charge in most cases. NO C.O.D. ORDERS ACCEPTED.

811-26/H36 DEC Writer II \$1495.00

811-26/H-36J DEC Writer II for 220 VAC, 50 Hz \$1495.00

H36-1 Fan-fold Paper for H36. Standard 14¾" x 11" white and green, single-part, lined paper. 3450 sheets per carton.

811-26/H36-1, Shpg. wt. 50 lbs. \$30.00

H36-2 EIA Interface. Provides EIA RS232-C Interface for LA36. 9-ft cable with 25-pin data-set type connector is also supplied. (DEC designation, LAXX-KG.)

811-26/H36-2, Shpg. wt. 1 lb. \$65.00

H36-3 Acoustic Coupler. Provides hookup to phone lines for time-sharing. Mounts in LA-36 with hardware provided. (DEC designation, LAXX-LM).

811-26/H36-3, Shpg. wt. 10 lbs. \$250.00

Some important counter buying tips

Frequency counter purchases, like most instruments, are based on specifications and features. But, there are numerous other factors that should be considered before you decide what brand or model to buy. Since specs and features are so important, let's consider them first.

Frequency Range is, on the surface, a straightforward specification, ie, how high will a counter count? The question to ask is, does the manufacturer specify a higher frequency than that guaranteed by the logic manufacturer? Heath counters are specified based upon the *guaranteed* specification of the logic.

Sensitivity specs tend to take extremes. The low sensitivity counter, ie, 200-400 mV, is restricted to limited applications. How do you measure the frequency of a low output oscillator circuit with such a counter? On the other hand, some claim 1 mV sensitivity. This restriction is obvious. In practical applications the noise on a signal will exceed the sensitivity of the counter giving erroneous readings.

A compromise is desirable and we at Heath have determined through years of experience that sensitivities in the order of 15-25 mV are the best for most applications.

Input Impedance — The input impedance desired depends on the application. At low frequencies (110 MHz or below) 1 M Ω input impedance is satisfactory. But remember, the input is always shunted by some parallel capacitance, typically 20-25 pf. Just determine the impedance of 25 pf at 500 MHz or

1 GHz. At 500 MHz it is 12 ohms and at 1 GHz it is 6 ohms. So that 1 M Ω is meaningless. Since the VSWR is directly proportional to the impedance, the VSWR is $\frac{1}{2}$ for 50 ohm cables at 500 MHz or 4.17. Line reflections play havoc with correct readings. So the meaningful impedance spec above 110 MHz is VSWR. Heath counters are guaranteed at less than 1.5 to 1 VSWR to 250 MHz and less than 2.0 to 1 VSWR at 1 GHz.

Resolution is determined by the number of digits and gate time. It is easy to be misled by simply considering the number of digits. Well-designed counters, like Heath's, always provide the proper number of digits and the proper gate times for resolution consistent with accuracy as defined below.

Accuracy is defined as time base accuracy ± 1 digit. Full specification for the time base must include an aging rate and a temperature stability figure. Many manufacturers do not specify either one or the other or both. Good time bases cost money and this is an obvious place to skip. A good temperature compensated crystal oscillator (TXCO), will have an aging rate of 5 ppm/yr and a temperature stability of 1 ppm over a range of approximately 0-40°C. To get guaranteed accuracy these must be added together if the counter is used at a temperature different than the calibration temperature. Thus, accuracy of a counter with these specs is 6 ppm. At 150 MHz this means the accuracy is ± 900 Hz ± 1 digit. Now that is still good percentage wise, since it is .0006% but, don't fool yourself into believing that resolution and

accuracy are the same thing. Just remember how important time base accuracy is and be wary of manufacturers who don't give both an aging rate and temperature stability specification. They may be hiding a 25 ppm or greater total spec by not mentioning it.

Features — A frequency counter can do more than count frequency. Heath counters can also be used as events counters and period meters. Period measurements are very handy for low frequency work since more display digits can be used to enhance resolution and the formula is simple $F = \frac{1}{P}$.

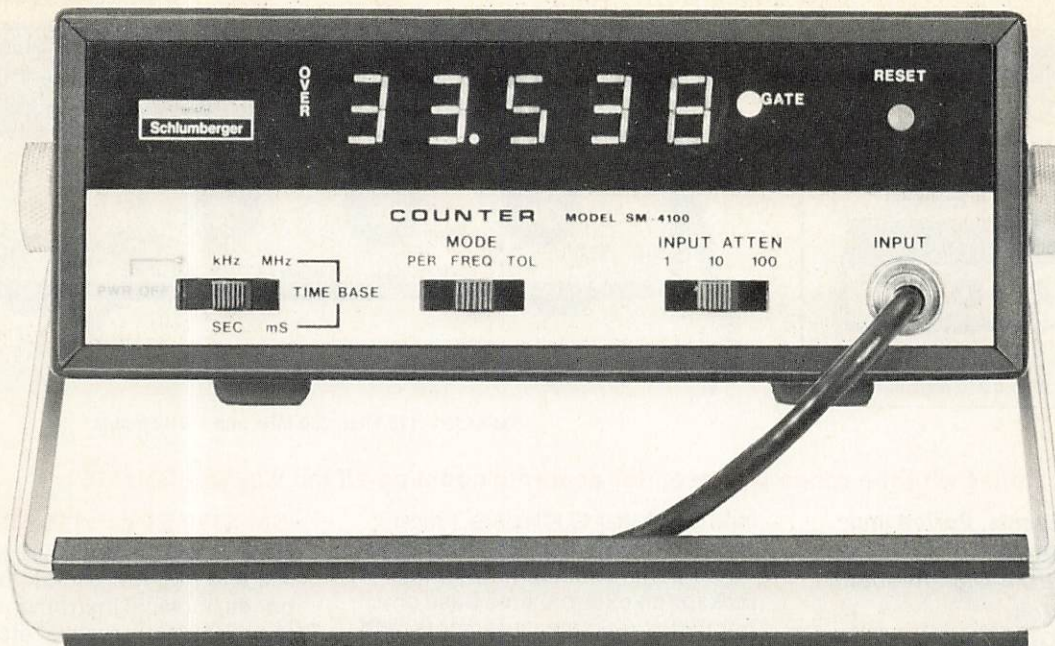
12 volt operation is a very desirable option particularly for mobile communications work. Our top of the line counters even include battery operation as an option.

Service is another "feature" that must be considered when making an instrument purchase. Heath has been making instruments for 30 years. Heath products are designed to be serviced by the customer. Heath maintains parts for at least 7 years after a product becomes obsolete. Heath has an excellent technical correspondence group ready and willing to help you with service problems. And, if all else fails, Heath factory service or the service facilities of our 50 Heathkit Electronic Centers are available at a *reasonable* price.

On a dollar per spec-feature-service comparison, Heath provides outstanding values in frequency counters. Just compare any frequency counter to the chart below and you'll be convinced.

	SM-109A	SM-4100	SM-4110	SM-4120	SM-4130
Frequency Range	0.1 Hz to 20 MHz	5 Hz to 30 MHz	5 Hz to 110 MHz	5 Hz to 250 MHz	5 Hz to 1 GHz
Inputs	0.1 Hz to 20 MHz	5 Hz to 30 MHz	5 Hz to 110 MHz	5 Hz to 110 MHz, 5 MHz to 250 MHz	5 Hz to 110 MHz, 5 MHz to 250 MHz, 100 MHz to 1 GHz
Input Sensitivity	20 mV RMS from 20 Hz to 20 MHz (250 mV, 0.1 Hz to 1 Hz)	15 mV RMS from 50 Hz to 30 MHz (50 mV, 5 Hz to 50 Hz)	25 mV RMS	25 mV RMS	25 mV RMS
Input Impedance	1 meg shunted by <20 pF	1 meg shunted by <35 pF	1 meg shunted by <25 pF	50 ohms, VSWR less than 1.5:1 110 MHz, same as 4110	50 ohms, VSWR, less than 2:1 110 MHz, same as 4110 250 MHz, same as 4120
Protection	Fused		250 V (DC + peak AC) to 100 kHz	5 Vrms	5 Vrms
Time Base Freq.	1 MHz	10 MHz	10 MHz	4 MHz TCXO	4 MHz TCXO
Aging Rate	<1 ppm/mo	<10 ppm/yr	<10 ppm/yr	<5 ppm/yr	<5 ppm/yr
Temp. Stability (0 to 40°C ambient)	± 10 ppm	± 10 ppm	± 10 ppm	± 1 ppm	± 1 ppm

Value And Unparalleled Performance



SM-4100 Frequency Counter

The Heath/Schlumberger SM-4100 is an unbelievable counter value.

It's a full five digit frequency counter. It also has a period mode and a totalize (events) mode. And, it provides built-in attenuation and 12 Volt operation, all in one compact package. The latest digital design and a stable 10 MHz crystal oscillator assure accuracy and precision on all measurements. Its excellent resolution makes it ideal for a variety of signal alignment applications.

When used as a frequency counter, the SM-4100 is guaranteed to 30 MHz with 1 Hz resolution. Sensitivity is a low 15 mV from 50 Hz to 30 MHz. Sensitivity from 5 Hz to 50 Hz is 50 mV.

Changing to the period mode is simply accomplished by a front panel selector switch. In the period mode intervals up to 99.999 seconds can be measured. Using the msec

time base, it resolves to 1 μ sec! The period mode can also be used for low frequency measurements with extremely high accuracy. Simply position the TIME BASE switch to mS and place the MODE switch in the PER position. Then solve the equation $f = 1/\text{period}$, using the displayed value.

The SM-4100 will add up (totalize) event pulses up to a count of 99,999 when switched to the totalize mode. Pushing the front panel reset button starts the count at zero. An inhibit signal can be applied through a rear panel terminal to stop the totalize mode at any time, without loss of the displayed count.

The front panel attenuator switch allows the amplitude of input signals to be divided by 1, 10 or 100. The gate indicator flashes on whenever the display is updating.

The SM-4100 also provides a positive overrange indicator. The indicator, positioned adjacent to the

display, indicates when the number to be displayed is larger than the display can handle.

A rear panel switch can easily be used to select either an internal or external time base. The rear panel connector can be used as an input for the external time base signal, or as an output to check the internal 10 MHz time base, or even to provide a convenient frequency standard of 1 MHz for bench use.

Switch selected 120 or 240 VAC operation is possible. Or the SM-4100 can be operated from any 12 Volt DC power source. No extra accessories are needed. Power is applied through a rear panel connector (mating connector supplied).

Add the Heath/Schlumberger SM-4100 to your equipment bench. Dollar for dollar, you will find more application value than with any other counter.

811-26/SM-4100, 6 lbs. . . . \$210.00

SM-4100 SPECIFICATIONS

FUNCTIONS:

Frequency: 5 Hz to 30 MHz.
(1 Hz resolution at 30 MHz)

Period: 1 μ sec resolution to 99.999 sec.

Totalize: 1-99,999 events.

INPUT:

Frequency Range: 5 Hz to 30 MHz minimum.

Sensitivity: 15 mV rms (50 mV, 5 Hz to 50 Hz).

Period Pulse Width: 25 nsec min.

Low Frequency Signal Risettime: 1 msec for signals less than 10 Hz.

Input Impedance: 1 megohm shunted by less than 35 pF.

Protection: 240 volts rms at 60 Hz.

Attenuator: X1, X10, X100 fixed compensation.

TIME BASE:

Frequency: 10 MHz.

Stability: ± 1 ppm.

Temperature Stability: ± 10 ppm, maximum 0° to 40° ambient.

OSCILLATOR CONNECTION:

External Input Frequency: DC to 20 MHz.

External Input Sensitivity: TTL or 2.5 V rms from 50-ohm source.

Internal Output: TTL signal at 1 MHz.

GENERAL:

Gate Interval: kHz-1 sec, MHz-1 msec (indicated by gate light).

Manual Gate: DC control in events mode using external OSC input connector.

Display Time: 200 msec plus gate interval.

Power Requirements: 105-130 or 210-260 VAC (switch selected), 60/50 Hz, (at 25 watts); or 9-14 VDC at 1.25 amperes.

Dimensions: 2 $\frac{3}{4}$ " H x 7 $\frac{1}{4}$ " W x 10 $\frac{1}{2}$ " D (less handle).

HEATH

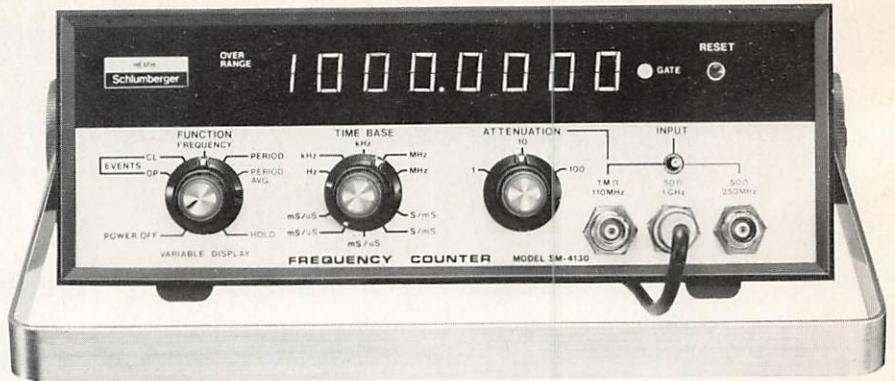
Schlumberger

High Performance Frequency Counters



SM-4110 — 110 MHz input

SM-4120 — 110 and 250 MHz inputs



SM-4130 — 110 MHz, 250 MHz and 1 GHz inputs

Choose the counter with the range you need for accurate counting all the way to 1 GHz!

- Frequency, Events, Period and Period Averaging
- Bright Red LED 8-Digit Readout
- Optional 12-Volt and Battery Operation
- Overrange and Gate Lamp Indicators

These Heath counters give you the accuracy and reliability you NEED for frequency counting on radio transmitters, hi-fi components, test instruments, any counting job! They offer excellent flexibility, accuracy and resolution, PLUS features you simply won't find on other counters in this price range.

A switchable attenuator on the 110 MHz input divides the input signal x1, x10 or x100 to facilitate accurate measurements of large amplitude signals. The time base switch selects the gate time and the resolution of the display. The 4120 and 4130 time bases are controlled by a high quality TCXO (temperature-controlled crystal oscillator) with a temperature stability of ± 1 ppm and an aging rate of < 5 ppm/yr for excellent stability. The 4110's crystal oscillator has temperature stability of ± 10 ppm and an aging rate of 10 ppm/yr. Separate 50-ohm inputs are used for frequency ranges above 110 MHz to maintain low VSWR, while

inputs below 110 MHz are 1 meg shunted by less than 25 pF. There's a rear panel oscillator input/output jack for an external time base or frequency ratio measurements, and it can be used as a signal source for breadboarding, calibrating or marker applications.

These counters include additional functions — events, period and period averaging. In events OP, the counting circuit increments for each input pulse with the resulting counts displayed. Events CL stops the events count and displays the accumulated total.

In the period mode, the readout displays a single period of the signal.

In the period averaging mode, the counter displays the time of a single period based on a 1000-period average. This results in a more accurate and higher resolution measurement. The counters feature rugged metal cases with non-marring front panels and a 12-position handle which rotates a full 360° for easy storage and mounting. The counter circuitry operates completely free of the case for easy service too. With input cable. Counters operate on 120/240 VAC (switch-selected), 12 VDC with SMA-4130-1 accessory at right, or portable battery operation with SMA-4130-1 and SMA-4130-2 batteries.

SM-4110 5 Hz to 110 MHz Counter

Applications include CB, low-band AM and FM, AM and FM broadcast bands, musical instruments, video tape systems, crystals, etc. Has single 110 MHz input.

811-26/SM-4110, 10 lbs. . . . \$330.00

SM-4120 5 Hz to 250 MHz Counter

For above applications, plus marine and aircraft radios, 2-meter and 220 FM, general lab work, more. Has 5 Hz to 110 MHz and 5 MHz to 250 MHz inputs.

811-26/SM-4120, 10 lbs. . . . \$530.00

SM-4130 5 Hz to 1 GHz Counter

For virtually every counting application including 450 FM, Military uses and land mobile. Has three separate inputs — 5 Hz to 110 MHz, 5 MHz to 250 MHz, and 100 MHz to 1 GHz.

811-26/SM-4130, 10 lbs. . . . \$865.00

12-volt converter for Counters

Mounts inside counter cabinet, permits 12-volt mobile operation of 4110, 4120 or 4130. Can also be fitted with 12 rechargeable nickel cadmium batteries (not included, order below) for portable operation.

811-26/SMA-4130-1, 3 lbs. . . . \$50.00

Set of 12 NiCad batteries.

811-26/SMA-4130-2, 4 lbs. . . . \$89.95

See chart on page 8 for major specifications.

OTHER SM-4110, 4120 and 4130 SPECIFICATIONS

Functions: Events: 1 to 99,999,999.

Period Resolution: 0.1 μ S.

Period Average: 1000 periods.

Period Pulse Width: 100 nsec min.

Low Frequency Signal Risettime: 1 msec to signals less than 10 Hz.

Attenuation: x1, x10, x100 fixed compensation.

TIME BASE: Setability: ± 0.1 ppm.

OSCILLATOR CONNECTION:

External Input Frequency: 1 MHz.

External Input Sensitivity: TTL or 2.5 Vrms for 50-ohm source.

External Input Protection: -5 V peak to +10 V peak.

Internal Output: > 1.5 V p-p into 50 ohms at 1 MHz.

TCXO Warmup: 10 minutes.

GATE INTERVAL: Frequency: 1 mS to 10 S (4 mS to 40 S on 1 GHz input).

Period: determined by period of input frequency.

Period Average: 1000 periods of input frequency.

Display Time: 200 mS to 20 S including a count hold position.

Power Requirement: 105-130 VAC or 210-260 VAC (switch-selected), 50-60 Hz at 35 watts; or 9-14 VDC at 2.5 A max. with SMA-4130-1 accessory.

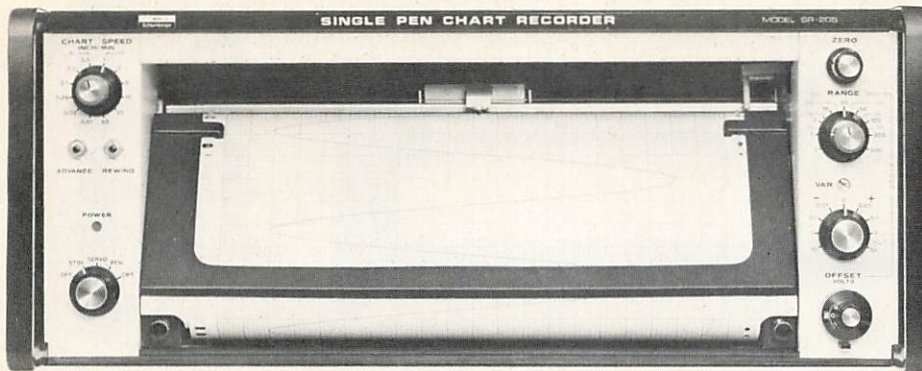
Dimensions: 10 $\frac{1}{4}$ " W x 13 $\frac{1}{4}$ " D x 4" (less handle).

Net Weight: 8 lbs.

HEATH

Schlumberger

Features, Function and Low Price



SR-205 Single Pen Strip Chart Recorder

- remote programming capability
- events markers
- electric pen lift

In the SR-205 (and SR-206 on the preceding page), Heath/Schlumberger has combined all the performance and capability you are likely to ever need. Each recorder is a complete system having remote programming capability, events markers, electric pen lift, two-speed pushbutton paper advance and rewind, necessary hardware for rack mounting and easy conversion to metric operation.

Digitally-derived chart speeds offer $\pm 0.1\%$ accuracy. Digital logic circuitry advances the stepper motor in exact increments. There is no backlash as is common in gear-train designs.

Complete remote control capability. Rear panel connectors allow total control from a remote location. This is particularly important when it is necessary to slave your recorder to a system such as a spectrophotometer or other analytical and laboratory equipment. Disposable nylon-tipped pens eliminate the need for pen filling and cleaning. There are even pens that write without bleeding at slow chart speeds.

A front panel zero control permits the pen to be set anywhere on the full 10-inch chart width with zero input. The floating pen servo provides full scale input ranges from 1 mV to 500 mV (or Volts) over 18 ranges. In addition to the calibrated control, a variable control permits full scale to be set anywhere between 1 mV and 700 V.

The SR-205 has a built-in calibrated offset to provide positive or negative 0-10 mV, 0-100 mV, 0-1 V or 0-10 V signal suppression. A switchable input filter adds an additional 20 dB of line frequency rejection to help eliminate noise.

Balance time is only 250 milliseconds for accurate response to fast changing signals. Maximum error is only $\pm 0.2\%$ of full scale.

Chart drive is quartz crystal controlled for stable chart operation. The twelve chart speeds range from 50 in/min to 0.01 in/min in a 1-2-5 sequence. An automatic take up spool is provided, or the chart paper may be fed out of the recorder and conveniently torn off for examination or filing. Front panel push-buttons provide two-speed chart advance or rewind for ease in retracing curves or locating specific portions of a trace. Chart paper may be advanced at any time without affecting performance.

Remote control by TTL-level signals for pen lift, chart drive, events marker and servo mute is possible through a connector on the rear panel. The mating connector is supplied.

The SR-205 has been designed for dependability and low maintenance. An enclosed conductive plastic slidewire is used for long life without periodic cleaning. The low inertia ball-bearing motor provides rapid pen acceleration. Pen motor current limiting circuitry allows the pen to be driven continuously off the scale with no audible noise and no possibility of damage to the recorder.

811-26/SR-205, factory tested and calibrated, 35 lbs. **\$1150.00**

811-26/SU-205-8 Retransmit Potentiometer, for transmitting pen position information from your SR-205 or SR-206 to an external device such as another recorder. Factory installed. Add \$90.00 per channel to recorder price.

Recorder pens and paper are listed on page 13.

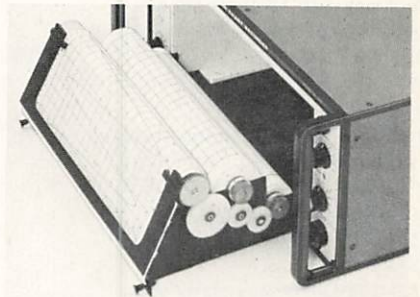


Chart paper may be fed out of the recorders, allowing pertinent notes to be added.

SR-205 & SR-206 SPECIFICATIONS

(All measurements except calibrated offset apply to both channels of the SR-206.)

Chart Width: 10 inches (25 cm with metric chart drive).

Input Ranges:

Calibrated: 1, 2, 5, 10, 20, 50, 100, 200, 500, mV or V full scale (10 inches). 1.25, 2.5, 6.25, 12.5, 25, 62.5, 125, 250, 650 mV or V full scale (25 centimeters).

Variable: 1 mV to 700 V full scale (inch). 1.25 mV to 700 V full scale (metric).

Input Characteristics:

Millivolt Ranges: Floating potentiometric, $\geq 5 \times 10^7 \Omega$ at null.

Volt Ranges: Floating with 10 megohms.

Zero Control Range: Zero may be set to any position on chart.

Zero Drift: $\leq 5 \mu\text{V}$ during warm-up (20 minutes). $\leq 1 \mu\text{V}/^\circ\text{C}$ thereafter.

Calibrated Offset Range: ± 0 to 10 mV, 0 to 1V, and 0 to 10V, $\pm 0.2\%$ of range setting, $\pm 0.005\%/^\circ\text{C}$. Multiply offset ranges by 1000 on VOLTS recorder ranges.

Balance Time: 250 mS (10 inches of travel).

Overshoot: 1% of full scale.

Overall Error: $\pm 0.2\%$ of full-scale maximum (on calibrated range).

Dead Band: $\leq 0.1\%$ of full scale.

Nonlinearity: $\leq \pm 0.1\%$ of full scale.

Range Switch Error:

Millivolt Ranges: $\pm 0.1\%$ of full scale.

Volt Ranges: $\pm 0.2\%$ of full scale.

Chart Speeds: 50, 20, 10, 5, 2, 1, 0.5, 0.2, 0.1, 0.05, 0.02, and 0.01 in/min (125, 50, 25, 12.5, 5, 2.5, 1.25, 0.5, 0.25, 0.125, 0.05, 0.025, and 0.0125 cm/min), quartz crystal controlled. May be driven by externally generated TTL level pulses.

Chart Speed Error: $\leq \pm 0.1\%$.

Line Frequency Rejection: 20 dB normal mode with filter "out," 40 dB common mode with filter "in," 100 dB common mode with filter "out," 1 k unbalance. 120 dB common mode with filter "in," 1 k unbalance.

Maximum Normal Mode Input Voltage:

Millivolt Ranges: 300 VDC or 400 V peak at ≥ 50 Hz.

Volt Ranges: 700 VDC or 700 V peak AC.

Maximum Common Mode Input Voltage:

Millivolt Ranges: 400 V.

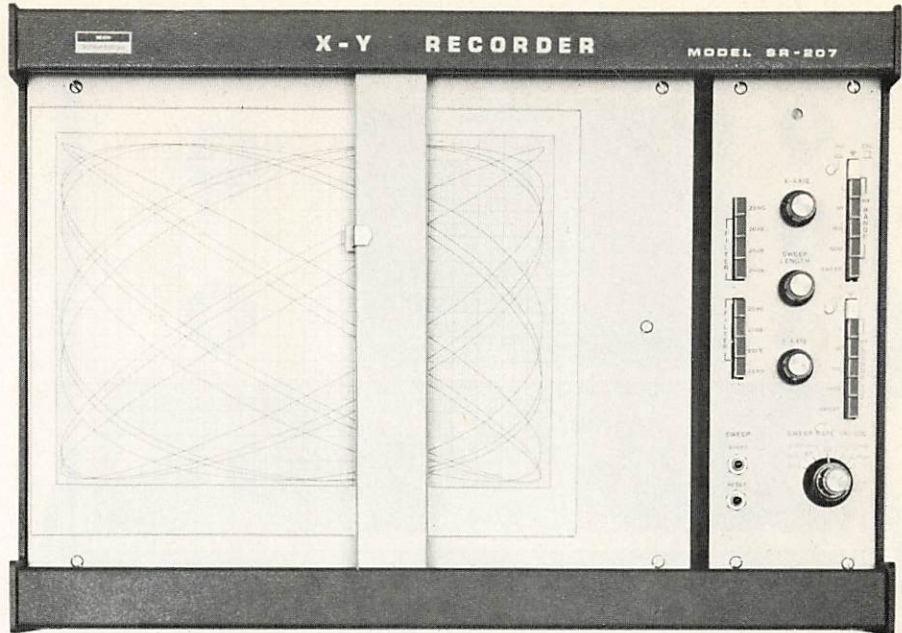
Volt Ranges: 400 V.

Operating Temperature Range: 10° to 40°C .

Power Requirements: 105-130 or 210-260 volts, 50-60 Hz; SR-205, 40 watts max; SR-206, 60 watts max.

Dimensions: 7" high (not including feet) 17½" wide, 13¾" deep. Standard rack will accommodate recorder when supplied adaptor is installed.

Net Weight: SR-205, 26 lbs.; SR-206, 30 lbs.



SR-207 X-Y Recorder

The Heath/Schlumberger SR-207 offers complete front panel controls for all functions assuring you of operational convenience in all applications. Front panel input filters allow the user to tailor the filters to his own requirements. Up to 60 dB of line frequency filtration in 20 dB increments is available to both coordinates.

The SR-207 provides an integral vacuum paper hold down so that it can be used in both a horizontal and vertical position without any modification.

Although normally used with standard 8½ x 11 graph paper, it can also use any type of special application paper that fits the plotting table.

The calibrated ranges of 1, 10, 100 mV and 1 V per inch are push-button selectable from the front panel. The SR-207 can reach from 1 mV/inch to 10 Volts/inch in the variable mode.

Electric pen lift is a standard feature. The pen can be placed anywhere on the chart with zero input on both coordinates, making it simple to re-trace specific portions of a trace. The SR-207 uses disposable nylon tipped pens, eliminating the need for pen filling and cleaning.

TTL compatible remote control operation for pen lift, sweep start

and servos add to the versatility of the unit and accuracy is outstanding for all characteristics of both coordinates.

811-26/SR-207, factory tested and calibrated, 30 lbs. **\$960.00**

All Paper (quantity price for same model no.): 1-9 rolls, **\$4.75 ea.**; 10-23

rolls, **\$4.50 ea.**; 24-96 rolls, **\$4.00 ea.**; 97-199 rolls, **\$3.50 ea.** Write for prices on orders exceeding 200 rolls. Shpg. wt. 2 lbs.

All Pens (quantity prices for same model no.): 1-9 pens, **\$3.00 ea.**; lots of 10, **\$18.00 lot**; lots of 100, **\$160.00 lot**. Shpg. wt. 1 lb.

CHART PAPER/PEN ORDERING GUIDE

• Indicates recorders in which chart papers & pens can be used.

CHART PAPER		SR-204 & SR-255B with inch drive	SR-204 & SR-255B with metric drive	SR-205 with inch drive	SR-205 with metric drive	SR-206 with inch drive	SR-206 with metric drive	SR-201A inch drive only	SR-207
811-26/SU-445-17 1/2 inch calibrated	0.5 inch major divisions	•		•		•		•	
811-26/SU-445-18 Centimeter calibrated	10 mm major divisions on both axes. Ruled 105-0-20 with 2 mm division on Y-axis.		•		•		•		
811-26/SU-445-21 Centimeter calibrated	Ruled 0 to 250 mm on Y-axis.		•		•		•		
PENS									
811-26/SU-406-92 Red	Disposable, nylon tip. Writes properly at any chart speed.	•	•					•	
811-26/SU-406-93 Blue		•	•					•	
811-26/SU-205-3 Red	Disposable, nylon tip. Long tip for second pen & events markers. For chart speeds under 1 min./in. (no bleed)			••	••	•†	•†		
811-26/SU-205-4 Blue				••	••	•†	•†		
811-26/SU-205-5 Red	Disposable, nylon tip. Long tip for second pen. For chart speeds over 1 in./min.					•‡	•‡		
811-26/SU-205-6 Red	Disposable, nylon tip. Short tip for chart speeds under 1 in./min. (no bleed)			•‡	•‡	•‡	•‡		•
811-26/SU-205-7 Blue	Disposable, nylon tip. Short tip for second pen. For chart speeds over 1 in./min.			•‡	•‡	•‡	•‡		•

* events only. † recording and events. ‡ recording only.

SR-207 Specifications

MECHANICAL:

Chart Size: 8½" x 11". (21.59 cm x 27.94 cm).

Sweep Speeds: 0.02, 0.1, 0.2, 1, 2 inches/second. (0.04, 0.2, 0.4, 2, 4 cm/second).

Balance Time: <1 second for full-scale deflection (both coordinates).

Overshoot: <1% of full scale.

ELECTRICAL (both coordinates):

Range: 1, 10, 100 mV/inch, 1 volt/inch (0.5, 5, 50, 500 mV/cm) cali-

brated. 1 mV/inch to 10 volts/inch (0.5 mV/cm to 5 volts/cm) variable.

Zero Control Range: Pen may be placed anywhere on chart with zero input to both coordinates.

LIMITS OF ERROR (both coordinates):

Overall Limit of Error: ±0.5% of full scale maximum.

Dead Band: <0.25% of full scale.

Non-Linearity: <±0.25% of full scale.

Sweep Speed: ±3%.

INPUT CHARACTERISTICS

(both coordinates):

Type: Single ended, independently floating.

Input Impedance: >10⁷ Ω on 1, 10, 100 mV ranges with <10 nA bias current. 10⁶ Ω on 1-volt range.

Line Frequency Rejection: Normal mode, 20, 40, 60, 80 dB (minimum) selected by front panel switch. Common mode, 80 dB (minimum) with filter OFF, 100 dB (minimum) with maximum filtering ON, with 1000 Ω unbalance.

Normal Mode Input Voltage (maxi-

um): 100 volts on 1, 10, and 100

mV ranges. 200 volts on 1-volt range.

Common Mode Input Voltage (maximum): 400 volts.

GENERAL:

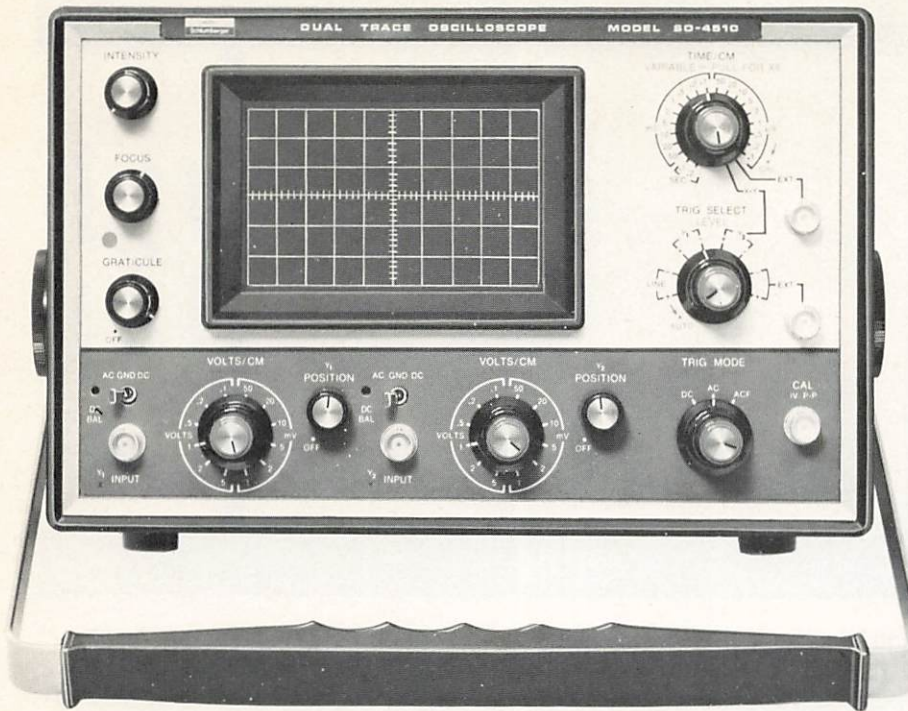
Power Requirements: 100-135 or 200-270 volts. 50-60 Hz, 35 watts maximum.

Ambient Temperature: 10-40°C.

Overall Dimensions: 5.656" H x 17.562" W x 12.25" D. (14.37 cm H x 44.64 cm W x 31.13 cm D).

Net Weight: 24 lbs. (10.89 kgs.).

X-Y RECORDER



SO-4510 Dual Trace Oscilloscope

Vertical input sensitivity of 1 mV/cm is provided over the entire bandwidth — not the 2-5 mV/cm sensitivity that is provided in similar scopes. With a x10 probe waveforms to 10 mV can be read — not the 50 or 100 mV found on other scopes.

The SO-4510 will typically trigger on signals up to 45 MHz and is guaranteed to 30 MHz with only 1 cm deflection. And, there is no stability control needed with the digitally controlled triggering circuits. In the automatic mode, a reference baseline is generated even when the trigger signal is absent. Complete triggering controls

are provided with choice of AC, ACF or DC coupling. The ACF fast coupling mode is provided to reject low-frequency components of the trigger waveform for accurate scope triggering. A trigger select allows triggering at any point on the vertical signal. For added convenience the 4510 offers you the ability to select a trigger signal from either channel A or B via a front panel switch.

You have a choice of normal or automatic sweep, and can use any one of 20 time bases from 0.2 sec/cm to 0.1 μ sec/cm. Any sweep speed can be magnified five times. With the SO-4510 you can also select an externally generated horizontal signal.

Internal delay lines insure the start of a horizontal sweep prior to the beginning of the vertical signal. The SO-4510 guarantees display of at least 20 nanoseconds of the pre-triggered waveform, insuring complete waveform display — mandatory for logic analysis.

Fully regulated power supplies provide stable voltages regardless of the varying line voltage conditions. An adjustable AC line switch is easily accessible and is used to match the regulated power supply to any common line voltage from 100 to 280 VAC. The 4 kV regulated post-acceleration potential of the CRT insures display brightness.

All major circuitry is located on five circuit boards for easy troubleshooting. Push on connectors permit fast removal of any board. Even the CRT can be removed and replaced in a matter of minutes. A calibrated 1 volt peak-to-peak square wave signal is provided through a front panel connector, allowing easy calibration checks and probe compensation adjustments. All in keeping with the Heath/Schlumberger philosophy of easy serviceability.

The Heath/Schlumberger SO-4510 offers the many features and specifications other manufacturers don't provide at anywhere near our low price.

811-26/SO-4510, factory tested and calibrated, 28 lbs. . . . \$810.00

SO-4510 SPECIFICATIONS

VERTICAL:

Deflection Factor:

Sensitivity: 1 mV/cm to 5 V/cm.

Attenuator: 12 steps in 1-2-5 sequence.

Variable: Continuous between steps to approx. 15 V/cm.

Accuracy: Within 3% (20°C to 30°C), 5% (10°C to 40°C) referenced to 0.2 V/cm @ 25°C.

Vertical Response:

DC Coupling: DC to 15 MHz (-3 dB).

AC Coupling: 2 Hz to 15 MHz (-3 dB).

Rise Time: 24 nanoseconds.

Overshoot: Less than 3%.

Delay Line: Allows display of at least 20 ns of pretriggered waveform.

Impedance: 1 megohm shunted by approx. 40 pF.

Maximum Input: 400 volts peak combined AC & DC.

Connector: BNC.

Vertical Modes:

Single: Y₁ or Y₂ selected by vertical position controls.

Dual: Chopped (200 kHz) or alternate automatically selected by Time Base switch.

HORIZONTAL:

Time Base:

Ramp: 0.2 s/cm to 0.1 μ s/cm.

Positions: 20 steps in 1-2-5 sequence.

Variable: Continuous between ranges to approx. 0.6 sec/cm.

Accuracy: Within 3% (20°C to 30°C), 5% (10°C to 40°C) referenced to 1 ms/cm @ 25°C.

Magnifier: X5 (adds additional 2% to sweep accuracy).

Sensitivity: 0.2 V/cm (approx.).

Impedance: 200 kilohms (approx.).

Polarity: Negative input causes right hand deflection.

Frequency Response: DC to 1 MHz (-3 dB).

Connector: BNC.

TRIGGER:

Internal:

Automatic: Zero crossing \pm 0.5 cm.

Normal: Adjustable over 8 divisions.

Slope Selection: + or -.

Automatic: Zero crossing \pm 0.2 volts.

Normal: Adjustable over \pm 5 volts.

Slope Selection: + or -.

Impedance: 1 megohm shunted by approx. 30 pF.

Connector: BNC.

GENERAL:

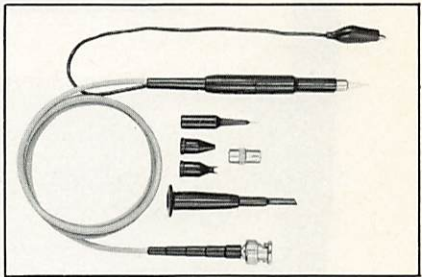
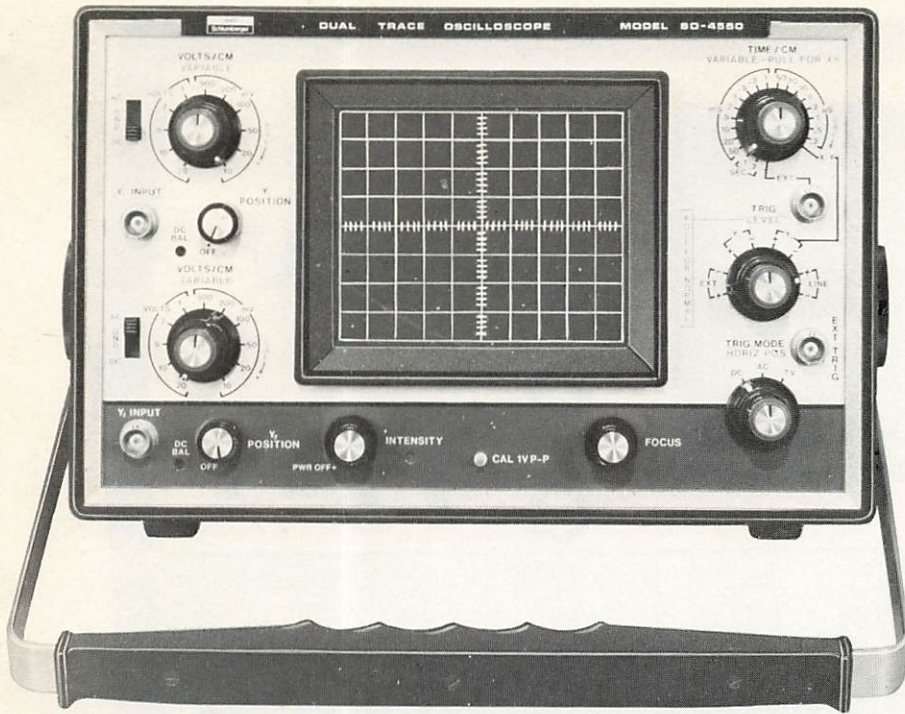
Voltage Range: 100 to 140 VAC/200 to 280 VAC, switch selected, 75 watts.

Internal Supplies: Fully regulated. Operating Temperature Range: 10°C to 40°C.

Dimensions: 6.4" H x 12.9" W x 19.3" D (handle extended).

Weight: 24 lbs.

General Purpose Dual Trace Scope



SO-4550 Dual Trace Scope

The Heath/Schlumberger SO-4550 is a dual-trace lab grade scope featuring a digitally controlled time base, automatic triggering, extra bright trace, fast writing speed and fast vertical rise time.

The 4550 has two vertical input channels with a maximum sensitivity of 10 mV/cm. Attenuator networks can be switched through 11 calibrated ranges in a 1-2-5 sequence to obtain deflection factors from 10 mV/cm to 20 V/cm. Variable settings between steps are also available. Vertical input signals are displayed chopped, or alternate, as selected automatically by the time base switch.

Calibrated horizontal time base ranges, from 0.2 sec/cm to 0.2 μ sec/cm can be switched in a 1-2-5

sequence through 19 steps. As with the vertical input, a variable allows any sweep speed between steps to be set. Any sweep speed can be expanded five times for a maximum sweep speed of 40 nsec/cm.

Trigger select switch and level control allow the time base to be precisely triggered at any point along the positive or negative slope of the trigger signal.

A calibrated 1 Volt peak-to-peak square wave signal (available through a front panel connector) allows easy probe compensation, vertical amplifier calibration and compensation. An astigmatism control is accessible through the rear panel.

811-26/SO-4550, factory tested and calibrated, 25 lbs. . . . \$565.00

Combination x1, x10 Scope Probe.

Has 2-position multiplier for x1 and x10 at probe tip. DC to 15 MHz (x1) and DC to 80 MHz (x10) bandwidths. x10 risetime, 4.0 nS. Compensation range of 15-50 pF. Includes probe with 3-position slide switch, 4 1/2 ft. cable. Accessories include a spring-loaded retractable tip cover, insulating tip, BNC tip adapter, IC tip and an insulated compensation capacitor adjustment tool. The insulating tip is designed for probing dense circuitry. A 3-position switch (one position grounded) precludes repeated switching of scope input to zero trace. Complete with vinyl case.

811-26/PKW-105, Shpg. wt. 1 lb. \$27.95

SO-4550 SPECIFICATIONS

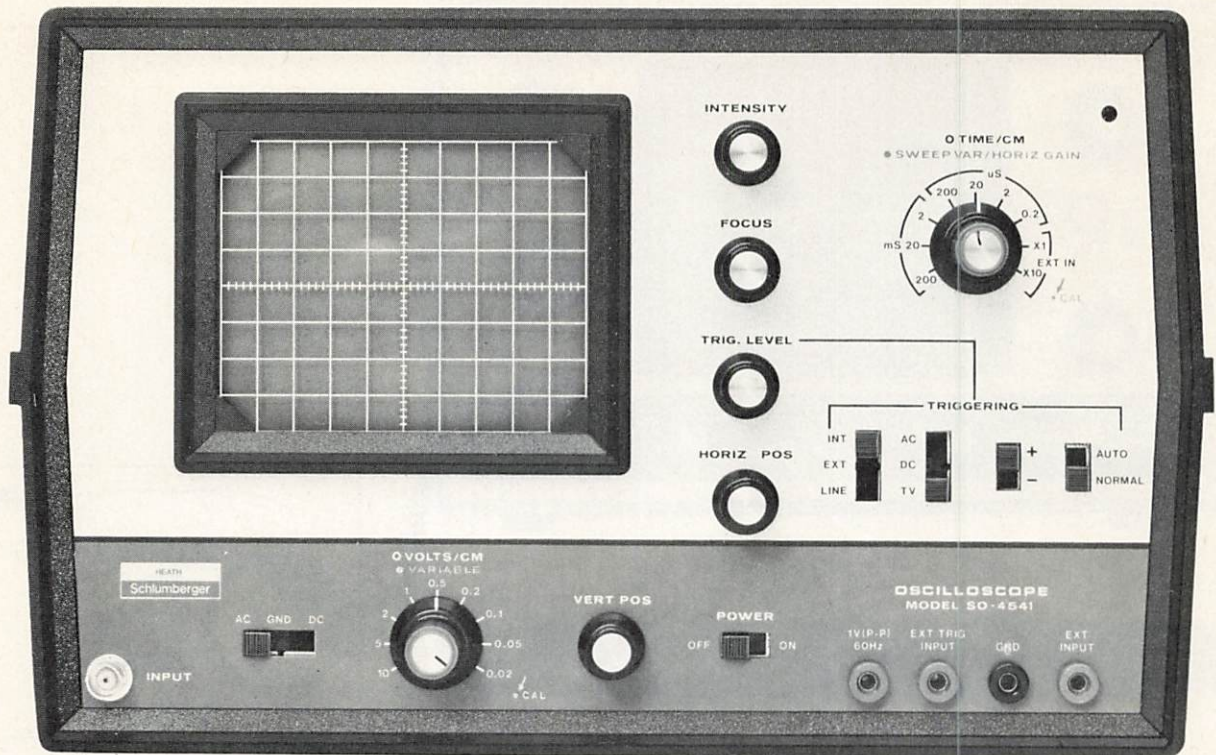
VERTICAL:
Deflection Factor: Sensitivity: 10 mV/cm to 20 V/cm.
Attenuator: 11 steps in 1-2-5 sequence.
Variable: Continuous between steps to approximately 60 V/cm.
Accuracy: Within 3%.
Vertical Response: DC Coupling: DC to 10 MHz.
AC Coupling: 2 Hz to 10 MHz.
Rise Time: 35 ns.
Overshoot: Less than 5%.

Vertical Input: Impedance: 1 M Ω shunted by 38 pF.
Maximum Input: 400 V.
HORIZONTAL:
Time Base: Ramp: 0.2 s/cm to 0.2 μ sec/cm.
Positions: 19 steps in 1-2-5 sequence.
Variable: Continuous between ranges to approx. 0.6 s/cm.
Accuracy: Within 3%.
Magnifier: X5 (adds additional 2% to sweep accuracy).
External: Sensitivity: 0.1 V/cm (approx.).

Impedance: 100 k Ω (approx.).
Frequency Response: DC to 1 MHz.
Connector: BNC.
TRIGGER:
Internal: Automatic: Adjustable over 10 divisions.
Normal: Adjustable over 10 divisions.
Slope Selection: + or -.
External: Automatic: Adjustable over 0.8 V.
Normal: Adjustable over 0.8 V.
Slope Selection: + or -.
Impedance: 1 M Ω shunted by 40 pF.
Connector: BNC.

X-Y: Y Channel: Same as Vertical.
X Channel: Same as vertical except response is limited to 1 MHz.
Phase Shift: Less than 8° @ 100 kHz.
GENERAL:
CRT: Type: 5" round.
Power: Voltage Range: 100-135 VAC/200-270 VAC switch selected, 70 watts at 120 VAC (240 VAC).
Internal Supplies: Fully regulated.
Operating Temperature: 10°C to 40°C.
Dimensions: 6.9" H x 12.9" W x 19.3" (without handle).

Triggered Single Trace Oscilloscope

**SO-4541 Single-Trace Scope**

The Heath/Schlumberger SO-4541 is a triggered scope with controls and features that are not found in other scopes in this price range. A stable triggering circuit is used for solid waveform displays (not the recurrent type sweep generator normally used in other scopes). Trigger controls include selection of normal or automatic modes, switch controlled AC or DC coupling and front panel input of external triggering signals. All front panel trigger controls are clearly labeled for "no mistake" operation. A special TV position on the trigger selector control allows low frequencies to pass while rejecting the high frequencies, so the 4541 will easily trigger on the vertical component of

a complex TV signal.

Any one of seven calibrated time bases, from 200 ms/cm to 0.2 μ s/cm can be selected by the time/cm switch. A variable control provides for settings between steps. The horizontal amplifier will accept external inputs from DC to 100 kHz.

Vertical input sensitivity of 20 mV/cm and nine calibrated vertical attenuator positions, up to 10 V/cm, will accommodate a broad range of input signals. A variable gain control gives precise control between settings.

Both vertical amplifier and horizontal sweep circuit power supplies are regulated to provide stable voltages to all circuits under varying line voltage conditions.

Accurate measurements are easily made from the bright 8 x 10 cm screen. A Mu-metal shield on the CRT reduces the effect of stray magnetic fields on the display. The lightweight, durable cabinet combines professional appearance with easy-to-carry portability. The flush mounted handle allows stacking to avoid an instrument-crowded bench. The DC-5 MHz bandwidth and excellent sensitivity input allow the SO-4541 to be used for nearly all types of waveform display and measurement applications. When you consider all the performance and features the SO-4541 provides, you can easily see why other scopes don't compare in value.

811-26/SO-4541, factory tested and calibrated, 19 lbs. . . . \$330.00

SO-4541 SPECIFICATIONS**VERTICAL:**

Bandwidth: DC to 5 MHz ± 3 dB.

Attenuator: 1, 2, 5 sequence, calibrated and variable.

Rise Time: 70 ns.

Overshoot: 5% at 1 kHz.

Impedance: 1 M Ω /38 pF.

Sensitivity: 20 mV/cm.

SWEEP:

Type: Triggered.

Range: 200 ms — .2 μ s, 7 steps plus variable.

Trigger Source: Int/Ext/Line.

Trigger Modes: AC/DC/TV; +/— Slope; Auto/Norm.

HORIZONTAL:

Sensitivity: .25 V/cm.

Bandwidth: DC to 100 kHz.

Impedance: 1 M Ω /50 pF.

Ext. Horiz. Input: X1 and X10 attenuator.

GENERAL:

CRT: 5DEP31F, 8x10 cm, green, medium-persistence

phosphor, 5" round, flat-face tube.

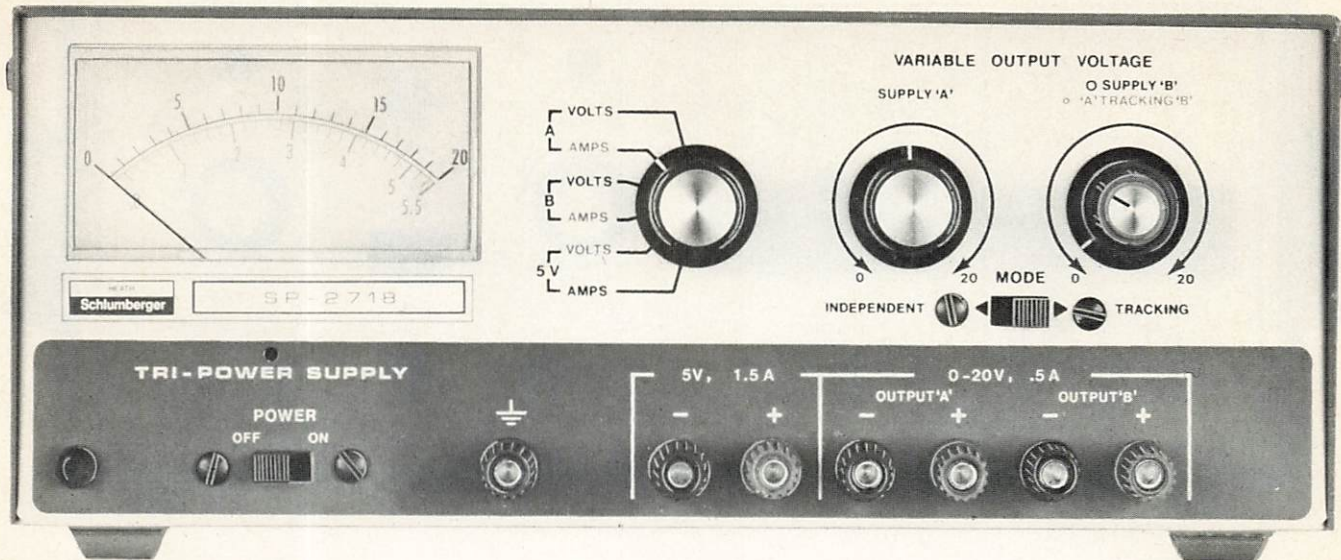
Accelerating Potential: Approx. 1.5 kV.

Graticule: Painted, 8x10 cm.

Power Requirements: 110-130 VAC or 220-260 VAC, 50/60 Hz, 35 watts.

Dimensions: 8" H x 13" W x 17" D.

Versatile Tri-Output DC Power Supply

**SP-2718 Tri-Output Supply**

Now you can combine a fixed 5 VDC output with two continuously adjustable 0-20 VDC outputs for circuit designs requiring more than one voltage supply. It's one of the lowest cost, most versatile power supplies you will find anywhere!

The outputs of the two 20 VDC variable supplies and the fixed 5 VDC output can be interconnected in any combination to provide both positive and negative voltages with a fixed reference, or they can be allowed to "float" at no reference level.

A clutch-coupled control allows the two 20 VDC supplies to "track"

each other at any specified voltage difference — ideal for analog circuits requiring both a positive and a negative voltage. The fixed 5 VDC at 1.5 A is useful for digital circuit design.

All three outputs are short-circuit proof, with automatic current limiting. For independent operation, each of the supplies may be floated at a level of up to 200 volts from ground, or from each other. Independent ground-referenced operation is also available with any of the output terminals, + or -, or connected to ground in any combination.

The SP-2718's two 20 VDC supplies

can be connected in parallel for higher current through the load. And, it may also be used for a variety of tracking and floating circuits.

The front panel has a switchable meter for monitoring voltage and current of all three supplies. Convenient binding-post terminals are used. An operating voltage of either 100-135 VAC or 200-270 VAC is switch selectable.

The variety of output voltages and output configurations make the solid-state Heath/Schlumberger SP-2718 an outstanding value.

811-26/SP-2718, factory tested and calibrated, 12 lbs. . . . \$185.00

SP-2718 SPECIFICATIONS**OUTPUTS:**

5-Volt Supply: 5 volts DC $\pm 5\%$ at 1.5 amperes.

'A'-Supply: 0-20 volts DC at 0.5 ampere, continuously adjustable.

'B'-Supply: 0-20 volts DC at 0.5 ampere, continuously adjustable.

REGULATION:

Load: Less than 0.1% (20 mV) variation from no load to full load on 20-volt supplies. Less than 2% (100 mV) variation

from no load to full load on 5-volt supply.

Line: 20-Volt Supplies: Less than 0.2% (40 mV) for a line voltage change of 10 volts.
5-Volt Supply: Less than 0.2% (10 mV) for a line voltage change of 10 volts.

Ripple and Noise: Less than 5 mV RMS.

Current Limiting: Limiting for each supply fixed slightly above rated current to provide short-circuit protection.

Tracking Range: 2 to 18 volts.

Tracking Error: Less than 1 volt.

Series Operation: All three supplies may be connected in series.

Parallel Operation: 20-volt supplies may be operated in parallel by adding 0.5 Ω current-equalizing resistors (not supplied).

Voltage-Current Monitor Accuracy: 5% of full scale.

Meter Ranges: Voltages, 0-20 and 0.5.5. Current, 0-550 mA and 0-2A.

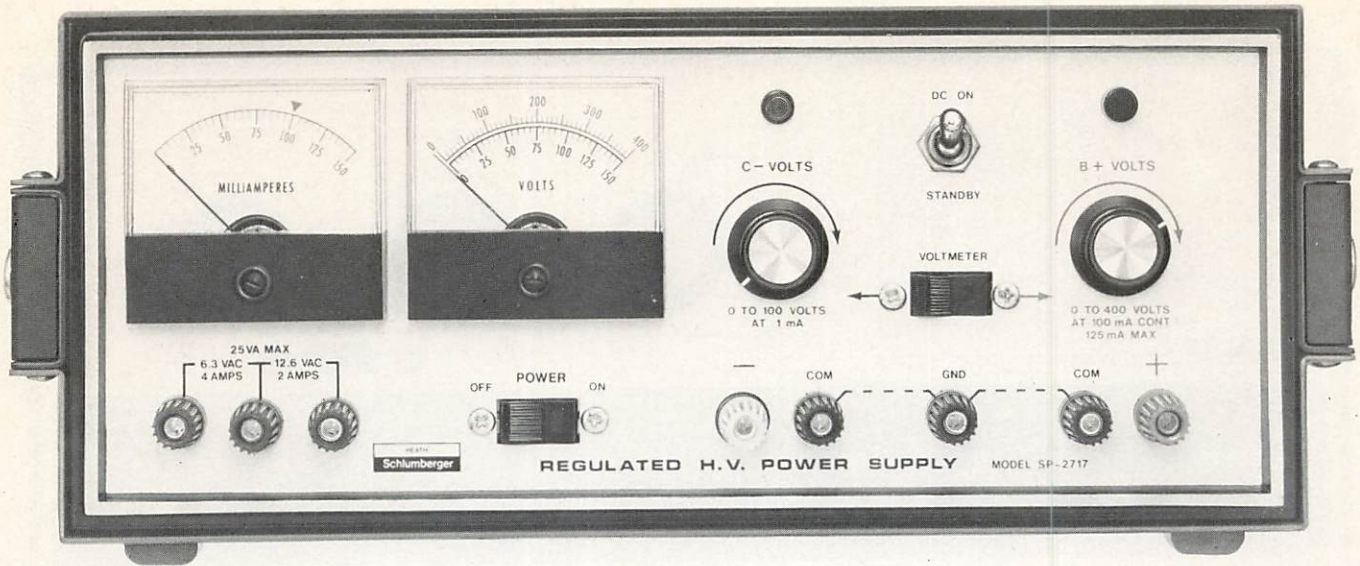
Power Requirements: 100-135 VAC or 200-270 VAC, 50/60 Hz, 100 watts at full load.

Power Switching Overshoot (On-Off): None.

Voltage Control, 20-Volt Supplies 'A' and 'B': Continuously variable, 0-20 volts.

Dimensions: 4 1/2" high x 10 3/4" wide x 9" deep (11.43 cm x 27.3 cm x 22.86 cm).

Weight: 10 lbs. (3.73 kg).



SP-2717 High Voltage Supply

- Provides B +, C- and filament supplies
- Separate voltage and current meters
- DC on/standby switch control

The SP-2717 provides the three most-used voltage ranges for work with tube circuits. B +, C- and filament voltages are all available in a single benchtop supply.

Bias voltage is adjustable from 0-100V at 1 mA, with a special control for fine adjustment of the lower voltages in the range. The B + output is regulated to better than 1%, no load to full load. Ripple and noise are less than 10 mV.

Filament voltages of 6.3 and 12.6

are available either independently or simultaneously, up to a maximum power output of 25 volt-amperes. Separate transformers are used for filament and high voltages so the filament circuit may be left on while switching off the high voltage circuit. This eliminates repeated tube warm-up time.

Built-in circuit protection if the bias voltage output circuit should accidentally be overloaded. The input circuit is fused for additional protection against overload conditions or short circuits.

Separate panel meters allow accurate monitoring of output current and voltage. The voltmeter is switch-selectable from the front panel for either the 0-400 or 0-150

VDC range. The front panel DC On/Standby switch instantly shuts off power to the load without having to disconnect the load physically. All output binding posts are insulated from the chassis to allow the high (B +) and bias (C -) voltages to be used as either positive or negative voltage sources.

The SP-2717 is a high voltage bench supply with all the features and performance you're likely to need, yet the price is realistically low. This power supply is a compact, convenient source of variable regulated high voltage, variable bias voltage and filament voltage for laboratories and service shops.

811-26/SP-2717, factory tested and calibrated, 19 lbs. . . . \$210.00

SP-2717 SPECIFICATIONS

B + VOLTS OUTPUT:

Voltage: 0 to 400 volts DC, regulated.

Current: 0 to 100 mA continuous; 125 mA intermittent.

Regulation: Output variation less than 1% from no load to full load for output of 100 to 400 volts DC. Output variation less than $\pm 1\%$ for a $\pm 10\%$ variation of the 115 volt or 230 volt AC input source.

Ripple: Less than 10 millivolts RMS ripple, jitter and noise.

Output Impedance: Less than

10 Ω from DC to 1 MHz.

C- AND FILAMENT VOLTS OUTPUT:

C- Volts: 0 to -100 volts DC at 1 mA.

Filament Voltage: 6.3 volts AC at 4 amperes, or 12.6 volts AC at 2 amperes.

NOTE: The 6.3 volt and 12.6 volt AC outputs may be used at the same time provided the total combined power does not exceed 25 volt - amperes.

GENERAL:

Output Binding Posts: Com-

mon and + (B+ voltage). Common and - (C- voltage). 6.3 VAC at 4 amperes. 12.6 VAC at 2 amperes. Chassis Ground.

Front Panel Controls: AC Power switch. DC On-Standby switch. Voltmeter switch. C- volts control. B+ volts control.

Circuit Board Controls: Zero Voltage Adjust. 400 Volt Adjust.

Meters:

Volts, Dual Scale: 0 to 400 and 0 to 150 volts DC (accu-

racy: $\pm 3\%$ of full scale).

Milliamperes: 0 to 150 mA (accuracy: $\pm 2\%$ of full scale).

Power Requirement: 105-125 volts or 210-250 volts, 50/60 Hz AC. 150 watts maximum.

Fuse: 1.5 ampere (105-125 VAC operation).

NOTE: A 1.0 ampere fuse (not supplied) is recommended for 210-250 VAC operation.

Dimensions: 13 $\frac{3}{8}$ " wide, 11 $\frac{1}{4}$ " deep, 5 $\frac{1}{2}$ " high.

Net Weight: 16 lbs.



SP-2700 Series Supplies

- True Constant Current or Constant Voltage
- Auto-Series and Auto-Parallel with Additional Power Supplies Capability
- Programming Mode
- Excellent Line and Load Regulation

These power supplies offer you a choice of digital or analog readout.

The digital model has two-decade auto-ranging to provide high resolution for low voltage and current settings. The analog supply uses a highly legible meter with $\pm 3\%$ accuracy at rated output.

Each supply can be operated in either a constant voltage mode or a constant current mode, (not simple current limiting, but fully specified constant current operation) which function independently of each other. Voltage level is controlled from the front panel, or from rear panel programming terminals.

The 2700 series provides full output protection. The fully dissipative regulator in these supplies allows indefinite short circuit operation with no damage. Output is protected against accidentally applied voltages. Loads are protected against open remote-sensing leads by limit-

ing an output voltage increase to less than 1.5 Volts. Output is isolated from the chassis for floating, negative ground or positive ground operation.

All power supplies can be connected for remote sensing of the voltage at the load to compensate for voltage drops caused by connectors and long leads. With local sensing, the voltage is monitored at the front or rear terminals.

Both voltage and current can be remotely programmed through the rear panel connectors for systems use and remote applications.

Power supplies can be connected in auto-series or auto-parallel configurations. Two power supplies of

the same rating can be connected in series to produce a voltage up to twice the rating of a single supply. Two or more supplies of the same rating can be connected in parallel to provide greater current capacity. Internal circuitry insures proper voltage tracking.

For powering breadboard circuits, or as a power source for bench use, these power supplies offer the stability and ease of operation you need for laboratory and industrial uses.

SP-2700 Series Model Specifications

Model	Readout	Maximum Rated Output		Readout Range		Regulation		Price
		Voltage	Current	Voltage	Current	Load	Line	
811-26/ SP-2710	Analog	30V	3.0A	0 to 30	0 to 3.0	(all models) voltage: 0.05% + 1 mV	(all models) voltage: $\pm 0.05\%$ + 1 mV	\$300.00 ship. wt. 34 lbs.
811-26/ SP-2711	Digital	30V	3.0A	0.00 to 19.99* 20.0 to 30.0	.000 to 1.999* 2.00 to 3.00	current: 0.10% + 3.5 mA	current: $\pm 0.10\%$ + 1 mA	\$370.00 ship. wt. 36 lbs.

SP-2700 Series Common Specifications

Ripple & Noise: Voltage: 1 mV RMS; 0.03% of rated output, peak-to-peak.

Voltage/Current Readout (Switchable): Analog: $3\frac{1}{2}$ " , 100 μ , meter. Digital: $3\frac{1}{2}$ -digit (9999), two-decade, auto-ranging, digital meter.

Readout Accuracy: Voltage: Analog $\pm 3\%$ of rated output; Digital $\pm 0.5\%$ of reading ± 1 count using laboratory standards, $\pm 1.0\%$ of reading ± 1 count using built-in calibrator. Current: Analog $\pm 3\%$ of rated output; Digital $\pm 1.0\%$ of reading ± 4 count using laboratory standards, $\pm 1.5\%$ of reading

± 4 count using built-in calibrator.

Approx. Readout Rate (Digital): 7 per second (60 Hz line freq.); 6 per second (50 Hz line freq.).

Readout Response Time: (Digital): 2 seconds to within 5 counts.

Stability at Output Terminals: Voltage: $\pm(0.01\% + 1 \text{ mV})/\text{hr}$. Current: $\pm 0.05\% + 1 \text{ mA}/\text{hr}$.

Stability as Displayed (Digital): Voltage: $\pm(0.01\% + 1 \text{ mV} + \frac{1}{2} \text{ count})/\text{hr}$. Current: $\pm(0.05\% + 1 \text{ mA} + \frac{1}{2} \text{ count})/\text{hr}$.

Temperature Coefficient at Output Terminals (10 $^\circ$ to 40 $^\circ$ C): Voltage: $\pm 0.01\% + 1.5 \text{ mV}/^\circ\text{C}$. Current: $\pm(0.05\% + 1 \text{ mA})/^\circ\text{C}$.

Temperature Coefficient as Displayed (Digital) (10 $^\circ$ to 40 $^\circ$ C): Voltage: $\pm(0.025\% + 2.0 \text{ mV})/^\circ\text{C}$. Current: $\pm(0.065\% + 1.5 \text{ mA})/^\circ\text{C}$.

Load Transient Recovery: Output voltage within $0.05\% + 1 \text{ mV}$ within 50 μ sec for rated output current change or 5A, whichever is less.

Output Voltage Overshoot: None; using Power Switch only.

Operating Modes: Constant voltage, constant current, auto-series, auto-parallel.

Programming Mode: Voltage: A — zero to rated output with 0 to 5.0 VDC applied; B — zero to rated output with 0 to 5000 Ω external resis-

tor. Current: Zero to rated output with applied voltage of 1.0 volt/amp for SP-2731). Programming Frequency Response: DC to 100 Hz, ± 2 dB. Programming Transient Response: 0.1 ms for low current to high current changes; 1.0 ms for high to low. Load resistance less than $10 \times E \text{ rated}/I \text{ rated}$

Power Requirements: 120/240 \pm 10/20 VAC; 50/60 Hz, 2.0/1.0 Amps max.

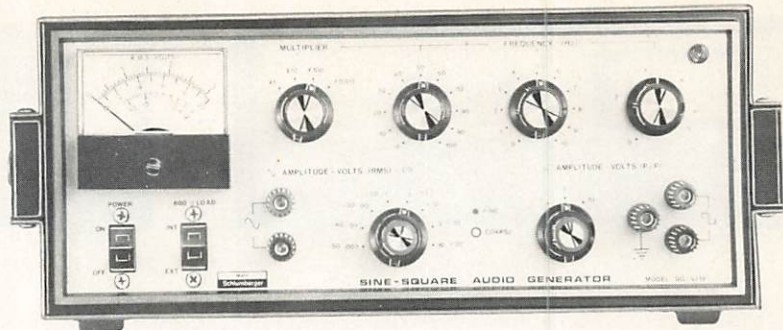
Overall Dimensions: 5.5" H x 15" W x 13.5" D.

NOTE: Specifications measured in accordance with NEMA Standards (PY1-1972) after 30-minute warmup period.

SG-5218 Sine-Square Wave Audio Generator

Sine wave signals are available from 1 Hz to 100 kHz with distortion less than 0.1% from 10 Hz to 20 kHz. Eight switch-selected output ranges from 3 mV to 10 Volts are available when operating into a high impedance (10 k ohm min.) external load. Six ranges from 3 mV to 1 Volt are provided for operating into the internal 600 ohm load or external load. A front panel meter monitors the sine wave output, and is conveniently calibrated in both volts and dB.

Square wave output is available from 5 Hz to 100 kHz with peak-to-peak output levels of 0.1 and 10 Volts into a load of 2000 ohms or greater. Risetime is 50 nanoseconds, making the SG-5218 ideal for testing audio amplifier response or



for use as a trigger for digital testing. The 0-100 and 0-10 ranges are switch selectable, as are the multipliers. A separate vernier control is used for frequency selection in the 0-1 range.

For measuring gain and frequency response in audio amplifiers, as a

signal source for harmonic distortion measurements or as an external modulator for RF signal generators, the Heath/Schlumberger SG-5218 is a low cost, versatile addition to any bench.

811-26/SG-5218, factory tested and calibrated, 10 lbs. . . . \$185.00

SG-1272 Low-Distortion Audio Frequency Oscillator

Truly low-distortion; less than .04% in the 40 Hz to 20 kHz range. Hum and noise are remarkably low at .01% or less. The SG-1272 provides a low-distortion, highly stable sine wave output over a frequency range from less than 5 Hz to 100 kHz. It's perfect for the testing requirements of the serious audiophile, audio service shop or the audio designer.

Pushbuttons select the first three significant digits of the desired frequency and also control the frequency multiplier and output attenuator. The SG-1272 can also be operated in a continuously-variable frequency mode. Typical SG-1272 uses include gain and distortion tests performed on either a single amplifier stage or an entire ampli-



fier; impedance measurements of an amplifier or similar circuit; and with an oscilloscope, frequency measurement of an unknown signal.

A level meter on the front panel allows visual monitoring of sine wave output. A BNC output connector helps keep noise level ap-

proximately 70 dB below signal output level. A buffered sync signal, for use with an oscilloscope or frequency counter, is available at the rear panel BNC. Includes cable, BNC, and clip leads.

811-26/SG-1272, factory tested and calibrated, 10 lbs. . . . \$230.00

SG-5218 SPECIFICATIONS

SINE WAVE OUTPUT:
Frequency Range: 1 Hz to 100 kHz.
Output Voltage Ranges: 0-.003, 0-.01, 0-.03, 0-.1, 0-.3, 0-1, 3-3, 0-10.
Internal Load: Internal 600 Ω load available on .003, .01, .03, .1, .3, and 1 volt ranges.
dB Ranges: -62 to +22 dB, -12 to +2 dB on meter; -50 to +20 dB in eight 10 dB switch positions. +2 dB maximum into 600 Ω load.
Output Variation: ± 1 dB from 10 Hz to 100 kHz.
Output Impedance: 10 volt range: 0-1000 Ω ; 3 volt range: 800-1000 Ω ; 1 volt range and lower: 600 Ω .
Meter Accuracy: $\pm 10\%$ of full

scale with proper load termination.

Distortion: Less than .1% from 10 Hz to 20 kHz.

SQUARE WAVE OUTPUT:

Frequency Ranges: 5 Hz to 100 kHz.
Output Voltage Ranges: 0-.1 V, 0-1 V, and 0-10 V zero-to-peak into 2000 Ω or higher load.
Output Impedance: 52 Ω on .1 V and 1 V ranges; Up to 220 Ω on 10 V range.
Rise Time: Less than 50 nanoseconds.
Frequency Error: Within $\pm 5\%$ of first and second digit.
Power Requirements: 105-125 VAC or 210-250 VAC, 50/60 Hz, 6 Watts.

Dimensions: 5 $\frac{1}{8}$ " high x 13 $\frac{1}{4}$ " wide x 7" deep.
Net Weight: 7 lbs.

SG-1272 SPECIFICATIONS

Output Voltage: .003 to 10 volts RMS.
Output Load: 600 ohms.
Hum and Noise: .01% or less.
Frequency Range: 5 Hz to 100 kHz.
Output Flatness (referenced to meter) Pushbutton Mode: Within ± 1.1 dB from 5 to 20 Hz; within ± 2 dB from 20 Hz to 100 kHz.
Output Flatness (referenced to meter) Variable Mode:

Within ± 2.5 dB from 10 Hz to 100 kHz.

Frequency Accuracy: Pushbuttons: $\pm 4\%$, ± 1 Hz, typical $\pm 1.5\%$. Variable; Depends on accuracy of counter being used.

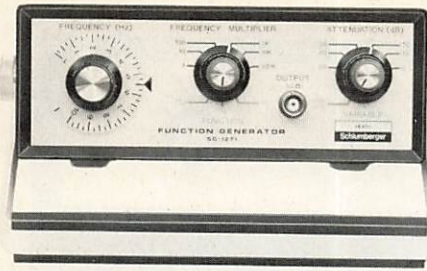
Distortion: 10 to 40 Hz; .1% or less. 40 Hz to 20 kHz; .04% or less. 20 kHz to 100 kHz; Rises to .1% at 100 kHz.

Attenuation: Pushbutton combination selected, 10 to 70 dB. Attenuation Accuracy: ± 2 dB. Selector Accuracy; ± 1 Hz $\pm 4\%$.

Power Requirement: 120 VAC or 240 VAC, 50 or 60 Hz. 10 watts maximum.

Dimensions: 5 $\frac{1}{2}$ " H x 11" W x 12 $\frac{1}{2}$ " D.
Weight: 9.5 lbs.

A Function Generator For Every Requirement



The Heath/Schlumberger SG-1271 Function Generator combines wide frequency range, compact size and superb engineering into a low-cost generator that will satisfy the most sophisticated requirements. All controls are located on the front panel for convenient operation, and clearly legible controls assure correct operation the first time.

A large tuning control allows fast and precise control of frequency over a 100:1 range. The six position

SG-1271 Function Generator

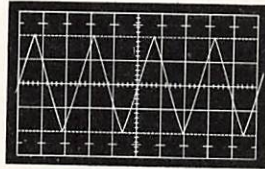
frequency multiplier is the only other control needed to set any frequency from 1.0 Hz to 1 MHz.

The output supplies a 10 Volt peak-to-peak signal into a 50 ohm load. A calibrated step attenuator adjusts from 0 to 50 dB in 10 dB steps — considerably more attenuation than offered by other function generators in this price range. The variable

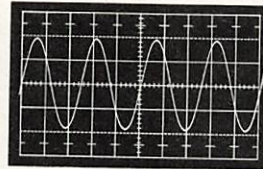
attenuator control provides up to 20 dB attenuation for each step.

The SG-1271 is an excellent educational tool. It remains fully operational with all its components exposed for classroom demonstrations. It is light weight and features an adjustable tilting handle.

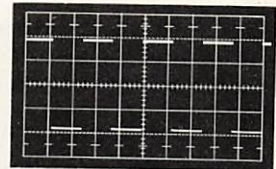
811-26/SG-1271, factory tested and calibrated, 7 lbs. \$185.00



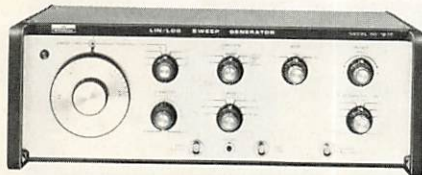
Triangle... maximum nonlinearity Waveform symmetry is maintained within 10% to 50% duty cycle.



Sine wave... harmonic distortion is 3% maximum from 5 Hz to 100 kHz.



Square wave... maximum rise or fall time is 100 nanoseconds with symmetry within 10% of 50% duty cycle.



A function generator with all the capability and accuracy you need. The SG-1275 is a reliable lab-grade function generator that provides sine, square and triangle waveforms PLUS swept-function waveforms for

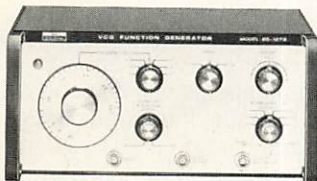
SG-1275 Deluxe Lin/Log Swept Function Generator

convenient frequency response tests. Also has pen lift and chart control signals for use with Heath chart recorders and others.

Six operational modes provide all the versatility you need for extensive test and service — Continuous output (CW); gated CW; a burst mode that completes a variable integral number of output cycles; linear and log sweeps for a 1000:1 sweep range. Stop and start frequencies are set independently; sweep modes

can also be triggered externally providing one sweep for each trigger, and stop for an integral number of cycles. Other convenient features include: A 50 dB switch attenuator variable between ranges; adjustable symmetry from 5% to 95%; variable offset; analog, sweep and sweep gate outputs for convenient system control; VCG input for external control of main generator.

811-26/SG-1275, factory assembled and tested, 16 lbs. \$530.00



SG-1273 Voltage-controlled Function Generator

An outstanding value for the budget-conscious technician, serviceman or experimenter. The SG-1273 is identical to the SG-1275 but does not include the swept function capa-

bility. All specifications (except swept function specs) are the same as for the SG-1275.

811-26/SG-1273, factory tested and calibrated, 14 lbs. \$370.00

SG-1271 SPECIFICATIONS

Frequency Range: 1.0 Hz to 1 MHz.
Frequency Accuracy: $\pm 3\%$ of full scale on dial.

FUNCTIONS:

Triangle Waveform: Nonlinearity, 5% maximum. Symmetry within 10% of 50% duty cycle.

Square Waveform: 100 nanosecond maximum rise or fall time. Symmetry within 10% of 50% duty cycle.

Sine Waveform: Harmonic distortions; 3% max., 5 Hz to 100 kHz.

Attenuator: 0 to 50 dB in 10 dB steps. 0 to 20 dB minimum variable, ± 1 dB accuracy.

Output: 10 volts peak-to-peak into 50 ohms. ± 1.5 dB flatness from

0.1 Hz to 1 MHz, 50 ohms impedance $\pm 5\%$.

Power Requirements: 105-130 volts or 210-260 volts RMS, 50-60 Hz. 15 watts max.

Operating Temperature: 0 to 40°C.

Dimensions: 3" H x 7 1/4" W x 8 7/8" D (without handle).

Net Weight: 4.2 lbs.

SG-1273/SG-1275 SPECIFICATIONS

Output: 50-ohm source — short circuit protected. ± 10 volts open circuit. ± 5 volts into 50-ohm load.

Output Flatness: ± 0.1 dB to 300 kHz. ± 0.5 dB to 3 MHz.

Output Waveforms: Sine — Triangle — Square. Symmetry continuously

variable 5% through 95% to 3000 kHz.

Frequency: 3 Hz through 3 MHz in 6 range steps on primary decade. 0.03 Hz on third decade of $\times 10$ range.

Sine Distortion: Less than 1%, $\times 10^1$. Less than 0.5%, $\times 10^2 \times 10^4$. Less than 0.75%, $\times 10^5$. Harmonics 30 dB down $\times 10^6$.

Triangle Linearity: No deviation greater than 1% to 300 kHz*.

Square-Wave Rise and Fall: Less than 60 nS.

Dial Accuracy: $\pm 3\%$ of full scale.

Attenuator: 0 to -50 dB in 10 dB steps. Variable control 0 to -20 dB.

DC Offset: Signal plus offset, limited to ± 10 volts open circuit

or ± 5 volts into 50-ohm load.

Time Symmetry: Within 1% of full period through 300 kHz*.

Sweep Generator: 6 ranges, 10 μ s through 1s. Each range may be extended by 100 with the variable control.

Sweep Output: Supplies 0 to 4.5-volt linear ramp at sweep generator rate from a 1000-ohm source.

Operating Temperature: 0° to 40°C ambient.

Power Requirement: 100 to 135 volts, 50-60 Hz, 20 watts maximum.

Dimensions: 15" wide, 11 7/8" deep, 5 3/8" high. 38.1 cm wide, 30.2 cm deep, 13.7 cm high.)

*Applicable only on top decade of each frequency range.

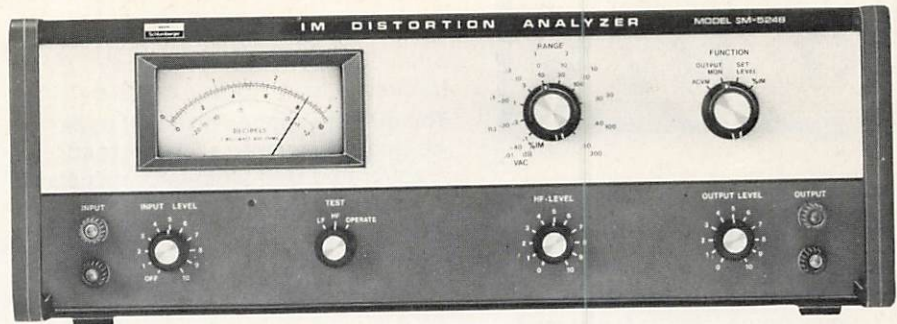
Versatile Audio Distortion Analyzers

SM-5248 Intermodulation Distortion Analyzer

Intermodulation distortion can be measured from 0.01% to 100% over six ranges in a 1-3-10 sequence. In the lowest range, 0-0.1%, measurements as low as 0.01% (plus residual) can be read with 5% full scale accuracy. Residual distortion is only 0.01% with internal generators.

Conformance to both SMPTE and IEEE standards is insured by use of internal 60 Hz and 7000 Hz oscillator outputs. Rear panel jacks allow you to use external generators for measurements to other standards. The internal oscillators can also be used as separate signal sources.

The 5248 features a built-in AC Voltmeter that measures from 0-10 mV



to 0-300 VAC in twelve switch-selected ranges. A wide response, 5 Hz to 1 MHz, with 5% full scale accuracy make it easy to set up associated AC voltage measurements without using external equipment.

Universal five-way binding posts let you use the SM-5248 with vir-

tually all associated equipment without special cables or adapters. An easily read front panel meter, input and output level controls, range and function switches make operation simple.

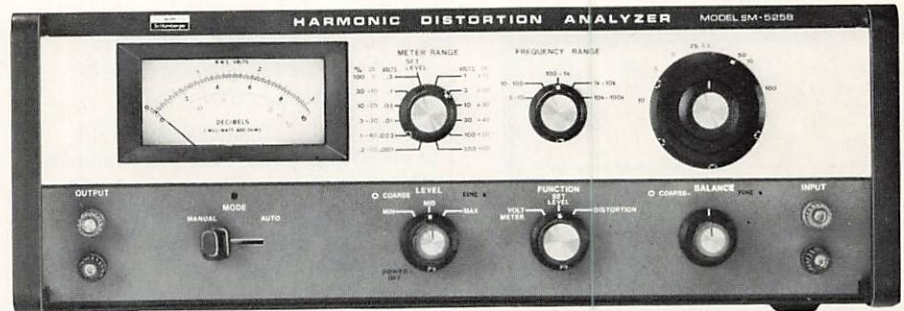
811-26/SM-5248, factory tested and calibrated, 15 lbs. . . . \$340.00

SM-5258 Harmonic Distortion Analyzer

The Heath/Schlumberger SM-5258 is the first harmonic distortion analyzer that costs less than \$1000 with an auto-null control. Simply "rough-tune" the analyzer and flip the auto mode switch. The analyzer automatically balances eliminating the need for delicate and time consuming manual fine-tune adjustments.

Harmonic distortion measurements can be made as low as 0.03% on the 0-0.3% range over a frequency range of 5 Hz to 100 kHz allowing you to check and service amplifiers and audio receivers claiming the finest specifications.

Residual distortion in the SM-5258 is a very low 0.03% or less. And, the front panel meter is accurate to within 0.5% of full scale. The meter is also capable of measuring AC



voltages from 0-1 mV to 0-300 VAC in twelve switch-selected ranges and includes an integral dB scale.

A level switch and level control provide the proper signal attenuation for all functions. Output binding posts let you monitor the measured

signal with an oscilloscope, external rms voltmeter or a wave analyzer. Input binding posts can be used with either wire leads or banana plug connectors.

811-26/SM-5258, factory tested and calibrated, 16 lbs. . . . \$430.00

SM-5248 SPECIFICATIONS

Ranges: 0.1 to 100% in a 1-3-10 sequence. Readable to .01% plus residual.

Residual: Less than 0.01% with internal generators.

Accuracy: 5% full scale.

Input Impedance: 1 megohm.

HF Sensitivity: 100 millivolts minimum.

Oscillator Frequencies: 60 Hz (line syncable), and 7000 Hz.

Generator Amplitude: Adjustable, 100 millivolts to 3 volts rms (50 millivolts to 1.5 volts into 600 Ω) with 60 Hz and 7000 Hz at a 4:1 ratio.*

Impedance and Bandwidths of External Oscillator Inputs: LF — 51 k ohms; 10 to 500 Hz. HF — 18 k ohms to 25 k ohms; 2 kHz to 100 kHz.

Impedance of Oscillator Outputs: 1000 ohms.

Connectors: 5-way binding posts.

AC VOLTMETER:

Sensitivity: 10 millivolts to 300 volts in a 1-3-10 sequence.

Input Impedance: 1 megohm.

Accuracy: 5% full scale.

Frequency Response: 5 Hz to 1 MHz, ±3 dB.

Power Requirements: 100 — 135 VAC or 200 — 270 VAC, switch

selected, 50/60 Hz, 15 watts.

Dimensions: 15" W x 11½" D x 5¾" H. 38.1 cm W x 29.2 cm D x 13.7 cm H.

Weight: 10 lbs., 4.5 kgs.

*60 Hz and 7000 Hz in 4:1 ratio conform to both SMPTE and IEEE standards for % IM distortion measurements.

SM-5258 SPECIFICATIONS

Frequency Range: 5 Hz to 100 kHz in 5 ranges: 5-10 Hz, 1-10 kHz, 10-100 Hz, 10-100 kHz, 100-1000 Hz.

Distortion: 0.3% to 100% full scale in 6 ranges with a 1-3-10 sequence.

Residual Distortion: 0.03% or less.

Input Impedance: 1 MΩ/70 pF maximum.

Required Input Level: 316 mV rms for distortion measurements.

Voltmeter: 1 mV to 300 V in 12 ranges with a 1-3-10 sequence.

Accuracy: 5% of full scale.

Output: 100 mV for full scale meter deflection.

Power Requirements: 100-135 V, 50/60 Hz, 12 watts. (200-270 switch selected.)

Dimensions: 15" wide, 11.5" deep, 5.38" high. (38.1 cm wide, 29.2 cm deep, 13.6 cm high.)

Weight: 12 lbs. (5.41 kgs.)

Solid State Digital and Analog Meters



SM-5238 AC Voltmeter

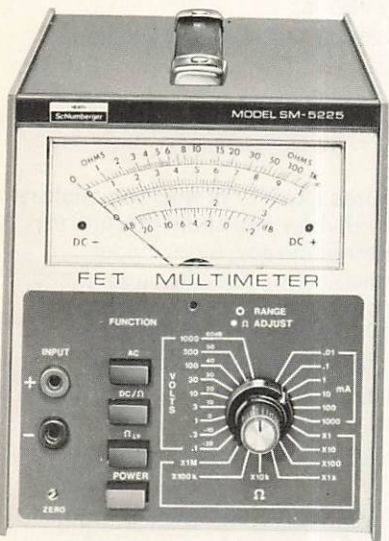
The Heath/Schlumberger SM-5238 is the first AC voltmeter to offer both a 3-decade linear dB scale and linear voltage scales. Not the familiar log function scales found on other voltmeters. If you have ever needed to measure low level signals, such as ripple or noise in a power supply, the SM-5238 now gives you the range and scale legibility you want from a meter. And for reading accuracy, the mirrored meter minimizes parallax errors.

The SM-5238 gives you twelve voltage ranges, from 0-1 mV to 0-300 VAC with an accuracy of $\pm 4\%$ of full scale. dB measurements can be made from -70 to $+40$ dB over twelve ranges in 10 dB

increments with an accuracy of ± 0.5 dB. The measurable frequency response of the SM-5238 is a superb ± 2 dB over a voltage range of 10 Hz to 1 MHz and ± 1 dB from 10 Hz to .5 MHz. This is all the meter capability you are ever likely to need.

Rear panel amplifier output and DC outputs proportional to meter reading make the unit useful for measuring small or large changes on a recorder. By using a Heath SR-207 X-Y recorder it is possible to set up a semi-automatic frequency response plotter. These features certainly enhance the SM-5238's versatility. It belongs in your service and measurement equipment inventory.

811-26/SM-5238, factory tested and calibrated, 8 lbs. \$160.00



SM-5225 Bench Model FET Multimeter

The SM-5225 is a stable, accurate top of the line FET multimeter designed primarily for bench operation. It will measure AC and DC voltages from 0.1 volt to 1000 volts and DC and AC currents from 0.1 mA to 1000 mA. Resistance from 1 ohm to 1 megohm may be measured on its seven resistance scales. High and low voltage ohms ranges allow for checking semiconductor junctions out of circuit or in circuit without causing semiconductor conduction.

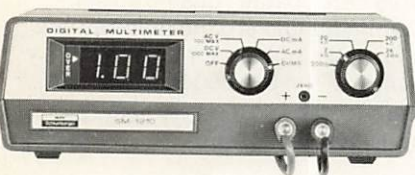
The SM-5225 is one of our easiest meters to use. A 24 position, continuous rotation range switch with concentric ohmmeter adjustment control and a 4-position pushbutton function switch make meter settings quick and easy. The SM-5225 also features automatic

polarity correction. Front panel LED's provide an indication of input polarity on DC functions and also serve as a pilot light.

The meter is overload protected. It will sustain 700 VAC (1000V peak) or 1000 VDC on the 1 volt to 1000 volt ranges. It will sustain 220 VAC or 300 VDC on any other range. A 2 amp quick blow input fuse, clamping diodes and clamping transistors provide meter circuit protection.

Incomparable features for the price. The SM-5225 is one of the best values you'll find anywhere. When you consider the performance and the features you can see why other multimeters don't even come close. Add it to your bench right away!

811-26/SM-5225, factory tested and calibrated, 8 lbs. \$185.00



SM-1210 Low-Cost Digital Multimeter

The SM-1210's large 2½-Digit display with automatic decimal positioning ends reading errors. Exclusive built-in calibration standards make periodic adjustments easy.

The full function capability includes AC voltage measurements up to 700 Volts. Four overlapping AC and DC voltage

and current ranges, and five resistance ranges make operation of the 1210 simple.

Accuracy is 1% on DC Volts, 1½% on AC Volts, AC/DC current and resistance. Front panel indicators show overrange, + or - DC voltages and current.

811-26/SM-1210 factory tested and calibrated, 5 lbs. \$110.00

SM-5225 SPECIFICATIONS

DC VOLTMETER

Nine Ranges: 0-0.1, 0.3, 1, 3, 10, 30, 100, 300, and 1000 volts full-scale.

Input Resistance: 10 M Ω .

Accuracy: $\pm 2\%$ of full scale.

AC VOLTMETER

Nine Ranges: 0.1 to 10,000.

DC MILLIAMMETER

Six Ranges: 0-0.01, 0.1, 1, 10, 100, 1000 milliamperes full-scale.

Accuracy: $\pm 2\%$ on 0.01 to 100 ranges. $\pm 3\%$ on 1000 range.

AC MILLIAMMETER

Six Ranges: 0-0.01, .1, 1, 10, 100, 1000 milliamperes full-scale.

Accuracy:

$\pm 3\%$ on 0.01 to 100 ranges. $\pm 4\%$ on 1000 range.

OHMMETER

Seven Ranges: $\Omega \times 1$ (10 Ω center scale), $\Omega \times 10$, $\Omega \times 100$, $\Omega \times 1K$, $\Omega \times 10K$, $\Omega \times 100K$, $\Omega \times 1M$.

Accuracy:

± 3 degrees of arc on $\Omega \times 1$ range (above 2 ohms). ± 2 degrees of arc on $\Omega \times 10$ to $\Omega \times 1M$ ranges.

DB RANGES

Nine Ranges: -40 to $+62$ (0 dB = 1 mW into 600 Ω).

Accuracy: ± 3 dB at -20 dB to ± 0.3 dB at $+2$ dB.

Operating Temperature: 0 to 50 degrees C. (32 to 122°F).

Dimensions (Overall): 5¾" wide x 6¾" high x 11¼" deep.

Weight: ¾ pounds.

SM-5238 SPECIFICATIONS

Voltage Range (full scale): 1 millivolt to 300 volts AC, 12 ranges.

Decibel Range: -70 dB to $+40$ dB; 12 ranges in 10 dB steps, variable offset.

Input: 10 megohms, 30 picofarads, negative input grounded to chassis.

Operating Temperature Range: $+10^\circ\text{C}$ to $+40^\circ\text{C}$.

Power Requirements: 100-135 VAC, 200-270 VAC, 50/60 Hz, 20 watts.

Dimensions (overall): 10¾" long x 5¾" wide x 6¾" high (27.6 x 14.3 x 17.2 cm).

Net Weight: 5.5 lbs. (2.5 kg).

SM-1210 SPECIFICATIONS

RANGES (Full Scale): DC Volts: 0-2, 20, 200, 1000 V.

DC Current: 0-2, 20, 200, 2000 mA.

AC Volts: 0-2, 20, 200, 700 V rms (25 Hz to 10 kHz).

AC Current: 0-2, 20, 200, 2000 mA rms (50 Hz to 10 kHz).

Ohms: 0-200, 2 K, 20 K, 200 K, 2 M ohms.

Power Requirements: 110-130 V, 50-60 Hz. 8 watts max. (200-270 V, 50-60 Hz by changing internal jumper wires).

Dimensions: 3" H x 8.69" W x 10.54" D.

Net Weight: 3.3 lbs.

Operating Temperature: 0-40°C.

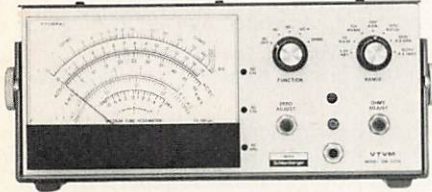
Meters With The Reliability You Need

**SM-5218 General Purpose VTVM**

Designed for use in radio and TV servicing, research and educational laboratories. A combination AC-OHMS-DC switching probe is used for measurements on seven AC, seven DC and seven Ohms ranges. Input impedance of 11 megohms on DC and 1 megohm/35 pF on AC minimize circuit loading. 1% pre-

cision network resistors provide excellent accuracy; wide ± 1 db, 25 Hz to 1 MHz frequency response permits a variety of AC measurements. Measures both rms and p-p AC volts.

811-26/SM-5218, factory tested and calibrated, 5 lbs. **\$110.00**

**SM-5228 Bench VTVM**

The SM-5228 is a service bench version of the SM-5218 described above. It features a rugged all-metal case with gimballed bracket for bench or shelf mounting. The large six-inch meter provides convenience and easy reading. All controls are front-panel mounted, including zero and ohms adjustments.

Solid-State Conversion Kit

Replaces the 6AL5 and 12AU7 tubes used in the SM-5218 and SM-5228 VTVM's. The solid-state devices plug into the tube sockets. The result is instant-on service, no more tube warm-up or pointer drift corrections.

811-26/IMA-18-1, factory tested, 1 lb. **\$19.95**

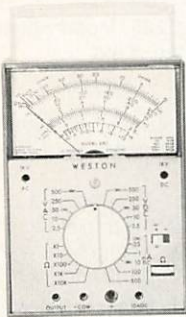
811-26/SM-5228, factory tested and calibrated, 7 lbs. **\$120.00**

**SM-666 Portable FET Multimeter**

It measures AC and DC voltage from 100 mV to 1000 Volts. AC and DC current from 1 μ A to 30 mA. Seven resistance ranges, from 1 ohm to 100 megohms and a special low voltage ohms circuit allows the SM-666 to make measurements on resistors in solid-state circuits without disconnecting component leads. Measures from -40 to +63 dB.

Features like 1% precision resistors in the divider and shunt circuits for greater accuracy, high impact thermoplastic case and ruggedized taut band meter movement make the SM-666 a tremendous value.

811-26/SM-666, factory tested and calibrated, 3 lbs. **\$195.00**

**SM-660 General Purpose VOM**

AC voltage measurement from 2.5 V to 1 KV and DC measurements from 250 mV to 1 kV with an accuracy of $\pm 2\%$ make the SM-660 an excellent value in an analog VOM. DC current to 10 amps and dB measurements from -10 to +56 dB make the unit a versatile performer.

DC polarity reversal switch, front panel thumbwheel adjustment for ohms measurement plus a strong, truly "droppable" case with self-storing handle are the features you should be looking for when you buy a meter. The SM-660 has them all.

811-26/SM-660, factory tested and calibrated, 3 lbs. **\$94.00**

Diode and fuse protected meter movement, calibrating controls,

SM-5218 SPECIFICATIONS

Meter scales: DC & AC (rms): 0-1.5, 5, 15, 50, 150, 500, 1500 V full scale.
AC peak-to-peak: 0-4, 14, 40, 140, 400, 1400, 4000 V full scale.
Resistance: 10 ohm center scale x1, x10, x100, x1000, x10k, x100k, x1 meg. Measures .1 ohm to 100 megohms.
Meter: 4 1/2" 200 μ A movement.
Accuracy: DC $\pm 3\%$, AC $\pm 5\%$ of full scale.
Battery requirements: 1.5 V, size "C" cell (not supplied).
Power requirements: 120/240 VAC, 50/60 Hz, 10 W.
Dimensions: 7 3/8" H x 4 1/16" W x 1 1/4" D.

SM-5228 SPECIFICATIONS

DC VOLTMETER — Ranges: 0-1.5, 5, 15, 50, 150, 500, 1500 V full

scale; up to 30,000 V with accessory probe.

Accuracy: $\pm 3\%$ of full scale.
AC VOLTMETER — Ranges: 0-1.5, 5, 15, 50, 150, 500, 1500 rms scales (.353 of peak-to-peak).
Accuracy: $\pm 5\%$ of full scale.
OHMMETER — Ranges: Scale with 10 ohm center X1, X10, X100, X1000, X10k, X100k, 1 meg. Measures 0.1 ohm to 1000 megohms with internal battery.
Battery: 1 1/2 V, "C" cell.
Power Requirements: 120/240 VAC, 50-60 Hz, 10 W.
Dimensions: 5" H x 12 1/16" W x 3 3/4" D.

SM-666 SPECIFICATIONS

DC VOLTAGE RANGES: 0.1, 0.3, 1, 3, 10, 30, 100, 300, 1000.
Accuracy: $\pm 2\%$ of full scale.
 Input Resistance: 10 megohms.

AC VOLTAGE RANGES: 0.1, 0.3, 1, 3, 10, 30, 100, 300, 1000.

Accuracy: $\pm 3\%$ of full scale.
RESISTANCE RANGES: x1, x10, x100, x1000, x10k, x100k, x1 Meg.
DC CURRENT RANGES: 1 μ A, 10 μ A, 100 μ A, 1 mA, 30 mA.
Accuracy: $\pm 3\%$ of full scale.
AC CURRENT RANGES: 1 μ A, 10 μ A, 100 μ A, 1 mA, 30 mA.
Accuracy: 0.1 μ A to 30 mA $\pm 4\%$ of full scale value.
DECIBEL RANGES: -40 to +62.
Batteries: Four 1.5V ("AA") cells, one 1.5V "D" cell (supplied).
Dimensions: 7" H x 5" W x 2 1/4" D.
 Test Leads: Supplied.

SM-660 SPECIFICATIONS

Sensitivity: 20,000 ohms/volt DC; 5000 ohms/volt AC.

Range: DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 volts.
AC Volts: 2.5, 10, 50, 250, 500, 1000 volts.
DC Current: 0.05, 1, 10, 100, 500 mA, 10 amps.
Ohms: 2000, 20,000, 200,000, 2 meg, 20 meg, full scale.
Decibels: -10 to +10, +2 to +22, +16 to +36, +30 to +50, +36 to +56.
ACCURACY:
DC Volts: $\pm 2\%$, 0.25 to 1000 V.
AC Volts: (.60 Hz), $\pm 3\%$, 2.5 to 1000 V.
DC Current: $\pm 1.5\%$, 0.05 mA, $\pm 2\%$, 1 to 500 mA, $\pm 2\%$, 10 amps.
Ohms: Approximately $\pm 2\%$ of scale length.
Batteries: 1 type D cell, 1.5 volts. 1 NEDA #208 battery, 15 volts (supplied).
Dimensions: 7" H x 5" W x 2 1/4" D.

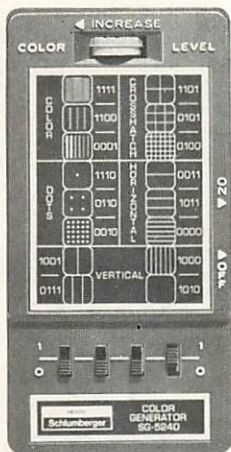


SM-4190 Bi-Directional Wattmeter

The SM-4190 bi-directional wattmeter covers the 100 MHz to 1 GHz spectrum without costly "slugs" or elements in applications to 300 watts. Power is measured on three forward scales (30, 75, and 300 watts) and three reflected (3, 7.5, and 30 watts) and because a unique "meter driving" FET amplifier has been employed in its design, the 4190 is capable of withstanding full power overloads on both of its lower scales without causing damage to the meter movement!

The SM-4190 is equipped with N-type coax connectors to insure low high-frequency insertion loss, features extremely rugged construction, and because of its size and metal D-ring for belt attachment, is ideal for tower antenna tuning and alignment procedures. Comes with N to PL-259 adaptors for easy hookup.

811-26/SM-4190, Factory tested and calibrated, 3 lbs. \$185.00



SG-5240 Portable Color Alignment Generator

The SG-5240 is a truly portable, "shirt-pocket" size, color alignment generator. It is no larger than the standard pocket calculator. And the textured finish plastic case eliminates the clothing snags and cabinet marring problems of other metal cased portables.

TV antenna terminals and you are ready to go.

The automatic turn-off feature shuts the 5240 off after five minutes of operation, thus eliminating the possibility of inadvertent battery discharge. The automatic turn-off can be overridden.

Four easy to use controls. Four front panel slide switches select the display patterns. The front cover display selection chart makes for quick and easy display of the desired pattern.

Crystal controlled carrier oscillators and sixteen test and alignment patterns will give you all the stability and versatility you are ever likely to need. The RF carrier frequency is calibrated for channel 4. Set up of the unit is easy. Simply attach the 300 ohm cable lead to the

811-26/SG-5240, factory tested and calibrated, 1 lb. \$95.00



ST-5230 CRT Rejuvenator/Tester

Test, clean and rejuvenate almost all current CRT's, including in-line-gun CRT's. Positive action pushbuttons control all tests and processes for easy operation. Individual guns can be cleaned, tested and rejuvenated by using the front panel pushbuttons. And, separate meters for each gun allow easy tracking of the individual grid currents. The main power control also sets the control grid voltage level. A separate heater voltage meter allows precision tracking of the heater voltage supplied to the cathode of the CRT.

mation of CRT short-circuits. The restore indicator glows brighter as the rejuvenating current is increased for visual indication of rejuvenation. A separate cleaning process is applied after rejuvenation to assure proper operation of the tube.

The ST-5230 is designed for portability. A rugged high-impact plastic case gives ample protection to the unit. The inside of the cover provides complete operational instructions for use in the field and a self-contained storage tray.

An indicator lamp gives visual confir-

811-26/ST-5230, factory tested and calibrated, 9 lbs. \$185.00

SM-4190 SPECIFICATIONS

Power Ranges: Forward: 30, 75, and 300 watts, full scale.
Reflected: 3, 7.5, and 30 watts, full scale.
Frequency Range: 100 MHz to 1 GHz.
Impedance: 50 ohms.
Accuracy: ±5% of full scale (30, 75 and 300 watt ranges), ±7.5% of full scale (3, 7.5, and 30 watt ranges).
Size: 4.5" H x 4.25" W x 4.625" D.
Power Requirements: 9-volt battery, NEDA 1604.

SG-5240 SPECIFICATIONS
DISPLAY PATTERNS*

Raster: Blank.
Horizontal Lines: 1, 7, 15.
Vertical Lines: 1, 11, 21.
 7 × 11 matrix.
Crosshatch: 1 × 1 matrix.
 15 × 21 matrix.
Dots: 1 × 11 matrix. 15 × 21 matrix.
Rainbow: No luminance.
Gated Rainbow: 3 bars with luminance. 10 bars with luminance.
Chroma Carrier: 3563.795 kHz ±0.005%, crystal controlled.
Master Timer: 377.616 kHz ±0.005%, crystal controlled.
RF Carrier: Channel 4; 67.250 MHz ±0.01%, crystal controlled.
 Optional Channel 3; 61.250 MHz

±0.005%, crystal controlled.
RF Output Level: 5000 μV minimum into 300 Ω.
 *The density of the displayed pattern depends on the overscan characteristics of the television set.
Video Modulation Percentage: 50% (approximately).
On Time Interval: 5 minutes minimum. OFF pushbutton switch can override time-out.
Power Requirements: Two 9-volt transistor batteries with 180 mAh capacity (NEDA #1604). (Not included).
Dimensions: 5.4" long × 2.75" wide × 1.15" high. (12.7 cm long × 6.99 cm wide × 2.91 cm high.)

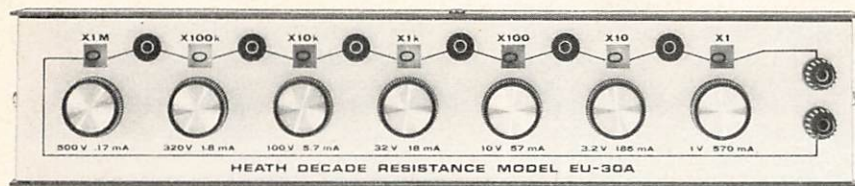
Weight: 0.5 lb. (0.225 kg).

ST-5230 SPECIFICATIONS

Sockets Supplied: 14-pin for 90° color tubes; 13-pin for in-line color tubes; 8-pin for black-and-white tubes; 7-pin for black-and-white tubes.
Heater Supply Voltage: Variable from 2 volts to 12 volts at 1 ampere.
Test Cables Supplied: 4' heavy duty.
Power Requirement: 105-135 VAC, 50/60 Hz (50 watts maximum at 60 Hz).
Dimensions: 5.12" high × 10" deep × 13.5" wide.



Finest Quality Instrument Accessories



Decade Resistance Box

The EU-30A Decade Resistance Box is an accurate instrument for use whenever precision resistors are required for an electrical measurement or circuit design. The extensive range of available resistance values makes it invaluable as a variable multiplier or shunt, a var-

iable substitution resistor, or as a leg for AC and DC bridges. Covers 1 ohm to 9,999,999 ohms in 1-ohm steps. Resistors are 1-watt, $\pm 0.1\%$ tolerance.

811-26/EU-30A, factory tested, 4 lbs. **\$95.00**

EU-30A SPECIFICATIONS

Range: 1 ohm to 9,999,999 ohms in 1 ohm steps.

Resistors: 1 watt precision, with $\pm 0.1\%$ accuracy, except those in the X1 decade which are $\pm 1\%$ accuracy.

Maximum Voltage and Current For Each Decade:
Decade: X1, X10, X100, X1k, X10k, X100k, X1M
Voltage (V): 1, 3.2, 10, 32, 100, 320, 500
Current (mA): 570, 185, 57, 18, 5.7, 1.8, 0.17.

Decade Taps: 6 taps terminated in banana jacks and wired between adjacent decades.

Switch Contacts: Solid silver alloy.

Minimum DC Resistance: Approximately 0.1 ohm at binding posts with all decades set at 0.

Temperature Coefficient: ± 100 ppm/degree C.

Readout: Numbered discs on switch shafts; visible through windows above each decade.

Dimensions: 2 $\frac{5}{8}$ " H x 13 $\frac{3}{8}$ " W x 2 $\frac{7}{8}$ " D.

Weight: 2 $\frac{1}{4}$ lbs.



RF fuse

UHF BNC-to-BNC connector containing replaceable RF fuse. Protects devices sensitive to RF power. DC to 500 MHz range; 50 ohms impedance; 1.2:1 VSWR (max.); insertion loss 1.80 dB max. at 500 MHz. Ten spare fuses included.

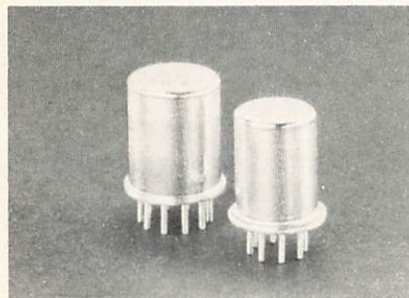
811-26/SU-512-50, factory tested, 1 lb. **\$45.00**



50-ohm termination

UHF termination used to eliminate improperly terminated cables which can cause incorrect count or no count in frequency counters and distorted waveforms in scopes. DC to 1 GHz range; power rating is 1 watt. VSWR: 250 MHz, 1.2:1; 600 MHz, 2.1.

811-26/SU-511-50, factory tested, 1 lb. **\$15.00**



IMA-18-1 Solid-State Conversion Kit

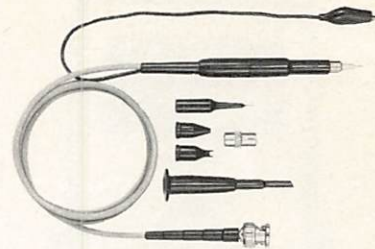
Replaces the 6AL5 and 12AU7 tubes used in the SM-5218 and SM-5228 VTVM's. The solid-state devices plug into the tube sockets. The result is instant-on service, no more tube warm-up or pointer drift corrections.

811-26/IMA-18-1, factory tested, 1 lb. **\$19.95**

Accessory Cables

For interconnecting instruments such as scopes, counters, etc. All cable is RG-58/U, 50 ohm characteristic impedance.

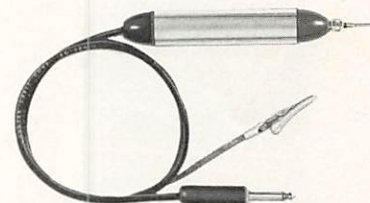
- 811-26/SU-501-3**, 3 ft., BNC/BNC, 1 lb. **\$7.50**
- 811-26/SU-501-6**, 6 ft., BNC/BNC, 1 lb. **\$7.50**
- 811-26/SU-503-3**, 3 ft., BNC/Banana, 1 lb. **\$7.50**



Combination x1, x10 Scope Probe

Has 2-position multiplier for x1 and x10 at probe tip. DC to 15 MHz (x1) and DC to 80 MHz (x10) bandwidths. x10 rise-time, 4.0 nS. Compensation range of 15-50 pF. Includes probe with 3-position slide switch, 4 $\frac{1}{2}$ ft. cable. See page 15 for more details.

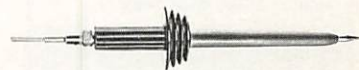
811-26/PKW-105, Shpg. wt. 1 lb. **\$27.95**



RF probe

Provides RF voltage measurement capability for any 11 megohm DC input voltmeter. Frequency response is linear from 1000 Hz to over 100 MHz. RF voltages of 90 volts rms or less can be easily measured, as well as RF voltages superimposed on DC potentials of 1000 V or less.

811-26/PKW-3, factory tested, 1 lb. **\$8.95**



30 kV DC probe

Provides X100 measurement capability for meters with 11-megohm input impedance (incl. probe resistance). Phone plug, alligator ground clip.

811-26/SMA-100-11, factory tested, 1 lb. **\$13.95**

PKW-101, PKW-104 Owners

Accessory Pack. Consists of the most commonly lost or damaged parts of the PKW-101 & PKW-104 probes. Includes three assembled tips, two 6-inch ground leads and one 12-inch ground lead.

811-26/PKA-101-1, accessory pack, 1 lb. **5.95**

Famous Self-Instruction Courses and NEW Classroom Versions too!

Electronic Education Courses for the Classroom

An exciting extension of a proven educational concept. Reformatted to fit the needs of the classroom student structure, these instructor-taught versions of our famous Continuing Education Courses consist of a separate instructor's guide, student workbook and text, and an electronics components kit for experiments. Students can now benefit from easy step-by-step learning procedures plus the personal knowledge and expertise of the instructor.

The **instructor's guide** incorporates all the information required by the teacher to guide the students through to successful completion of the course. Included are complete course outlines, objectives, answers to unit examinations and a guide to aid the instructor in the preparation of a final examination. Also provided are suggested guidelines on how to use the course and what to expect from the students.

The **student textbook** utilizes the same successful step-by-step approach to learning

that has made our Self-Instruction Courses so very effective. Profuse illustrations and clear, concise writing make for a high degree of student comprehension. Self-test questions and programmed instruction reviews help the student's understanding as he progresses.

Accompanying the text is the **student workbook**. Keyed to the text, the student workbook contains detailed chapter examinations and numerous, interesting experiments that give the student firsthand experience with the subject material. Whenever needed, graphic illustrations are used to ensure understanding. The text and workbook complement and support each other perfectly. A parts kit containing the electronic components necessary to perform the course experiments is also available. The parts and experiments were designed for use with the optional ET-3100 Electronics Trainer and the ET-3200 Digital Trainer which provide a low-cost and effective way to perform course exercises. Each Unit, Shpg. Wt. 1 lb.

Quantity discount schedule available for these courses.

Brochures detailing course objectives and outlines are available upon request.

Course	Student Text	Price	Student Workbook	Price	Instructors' Guide	Price	Parts Kit	Price
DC Electronics	EB-6101	15.95	EB-6101-40	6.95	EB-6101-50	8.95	EB-6101-30	13.95
AC Electronics	EB-6102	15.95	EB-6102-40	6.95	EB-6102-50	8.95	EB-6102-30	8.95
Semiconductor Devices	EB-6103	15.95	EB-6103-40	6.95	EB-6103-50	8.95	EB-6103-30	8.95
Electronic Circuits	EB-6104	17.95	EB-6104-40	7.95	EB-6104-50	8.95	EB-6104-30	19.95
Digital Techniques	EB-6201	19.95	EB-6201-40	9.95	EB-6201-50	8.95	EB-6201-30	17.95

Begin Learning with DC Electronics

Your first step on the way to a complete understanding of electronics, DC electronics covers the following: Electron theory; current flow; voltage; resistance; Ohm's Law; magnetism; electrical measurements; network theorems; inductance and capacitance. In addition to that mentioned above, you will learn the relationship between electricity and magnetism and you will be able to solve basic electronic problems involving current, voltage, resistance and power, convert from one metric prefix to another and work with powers of ten, build and experiment with basic DC circuits of your own design, explain the construction, operation and function of resistors, potentiometers, switches, fuses, relays, capacitors, inductors and batteries. You will also be able to use a

multimeter to measure voltage, current and resistance, draw equivalent circuits using a diagram as a guide, and construct DC circuits from a schematic diagram. Includes text, records and 56 electronic components for 20 experiments.

If you choose to take the optional final exam, a passing grade earns you 2.0 Continuing Education Units and a Certificate of Achievement. CEU's are a nationally recognized means of acknowledging your participation in formal non-credit adult education.

811-26/EE-3101, 6 lbs. \$39.95

811-26/EEA-3101, Cassettes*, Shpg. wt. 2 lbs. \$6.95

811-26/EWS-3101, EE-3101 plus ETW-3100 Experimenter/Trainer, 19 lbs. \$129.95

Move on to AC Electronics

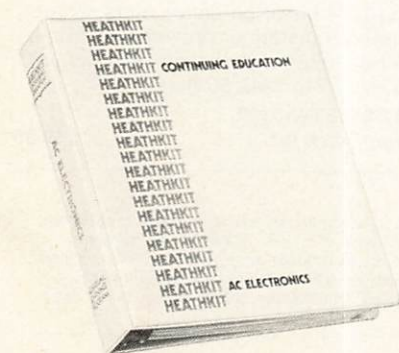
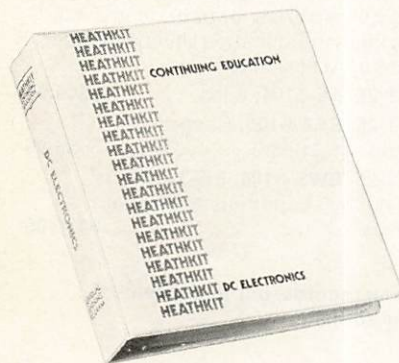
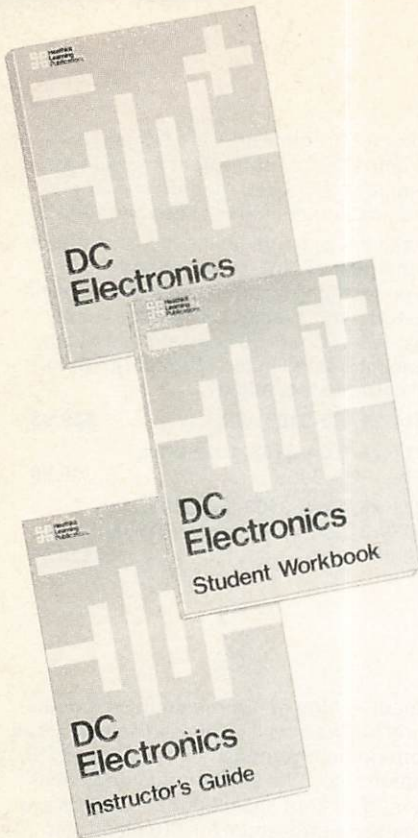
This course covers AC fundamentals; AC measurements; capacitive circuits; inductive circuits; transformers and tuned circuits. In addition to that mentioned above, you will learn to explain the difference between AC and DC, describe the operation of a simple AC generator, explain basic transformer action, explain the operation of series and parallel resonant circuits, determine the average or effective value of an AC sine wave when its peak or peak-to-peak value is known, determine the frequency of an AC waveform when its period is known, explain how AC meters are used to measure current, power and voltage, analyze simple AC circuits that contain resistance or a combination of resistance, capacitance

or inductance, describe the electrical properties of capacitance and inductance and more. DC Electronics (above) or equivalent knowledge is the prerequisite for this course. Includes text, records and 16 electronic components for 8 experiments. If you choose to take the optional final exam, a passing grade earns you 1.5 Continuing Education Units and a Certificate of Achievement. CEU's are a nationally recognized means of acknowledging your participation in formal non-credit adult education.

811-26/EE-3102, 6 lbs. \$39.95

811-26/EEA-3102, Cassettes*, Shpg. wt. 2 lbs. \$6.95

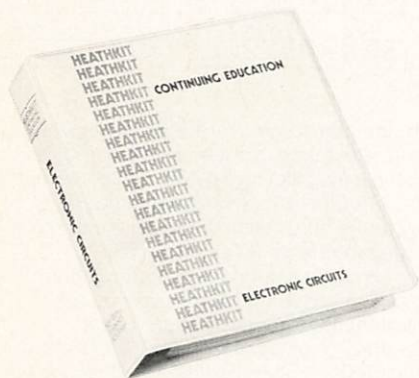
811-26/EWS-3102, EE-3102 plus 19 lbs. \$129.95





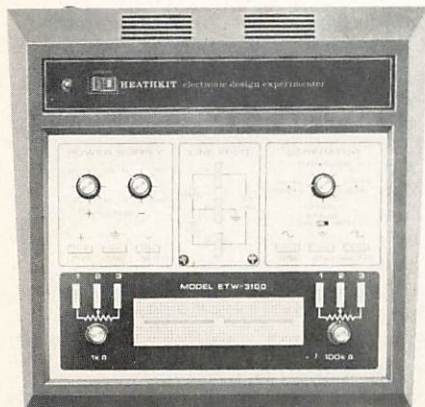
Learn how semiconductor devices are used in actual circuits

- FET's
- Thyristors
- IC's
- Diodes
- Zener Diodes
- Fundamentals
- Bipolar Characteristics
- Optoelectronic Devices
- Special Diodes
- Bipolar Transistor Operation



Explains the operation of all the most common solid-state electronic circuits

- Basic amplifiers
- Typical amplifiers
- Power supplies
- Operational amplifiers
- Oscillators
- Pulse circuits
- Modulation



Semiconductor Devices

One of the most important of our Self-Instruction series, this course covers semiconductor fundamentals; diodes; Zener diodes; special diodes; bipolar transistor operation; bipolar characteristics; field effect transistors; thyristors; integrated circuits and optoelectronic devices. Learn in addition to what is mentioned above; how to describe the electrical characteristics of semiconductor materials, how to properly handle sensitive semiconductor materials, how to recognize the most commonly used semiconductor devices, and how to test various semiconductors for proper operation. Proceed step-by-step in a no pressure learning environment, study when and progress when ready. It's one of the easiest ways to learn this challenging

course. Prerequisites are DC and AC Electronics (or equivalent knowledge). Included are texts, records and 27 electronic components for 11 experiments.

Take the optional final exam and a passing grade of 70% or better earns 3.0 Continuing Education Units and a Certificate of Achievement. The knowledge gained in Course 3 is invaluable to anyone interested in today's state-of-the-art electronic technology.

811-26/EE-3103, 6 lbs. \$39.95

811-26/EEA-3103, Cassettes*, Shpg. wt. 2 lbs. \$6.95

811-26/EWS-3103, EE-3103 plus ETW-3100 Experimenter/Trainer, 19 lbs. \$129.95

Electronic Circuits

This course covers the operation of all the most common solid state electronic circuits: basic amplifiers; typical amplifiers; operational amplifiers; power supplies; regulators; oscillators; pulse circuits; modulators and demodulators. In addition to that mentioned above, it teaches how to analyze and design simple inverting and non-inverting amplifiers that use operational amplifiers, the basics of oscillation and how to identify and describes the operation of commonly used LC, RC and crystal oscillators. Learn about pulse circuits and multivibrators and study amplitude and frequency modulation including SSB. Learn how to use a voltmeter and an oscilloscope to analyze the operation of electronic circuits. This brings all the

theory of the first three courses together and shows how it applies in actual circuit operation. Prerequisites are AC and DC electronics and semiconductor devices (or equivalent knowledge). Included are texts, records and over 110 electronic components for 18 experiments.

Take the optional final exam and a passing grade of 70% or better earns 4.0 Continuing Education Units and a Certificate of Achievement.

811-26/EE-3104, 8 lbs. \$49.95

811-26/EEA-3104, Cassettes*, Shpg. wt. 2 lbs. \$6.95

811-26/EWS-3104, EE-3104 plus ETW-3100 Experimenter/Trainer, 19 lbs. \$139.95

*Optional Cassettes duplicate materials on records, but in convenient, easy-to-use cassette format.

Basic Experimenter/Trainer

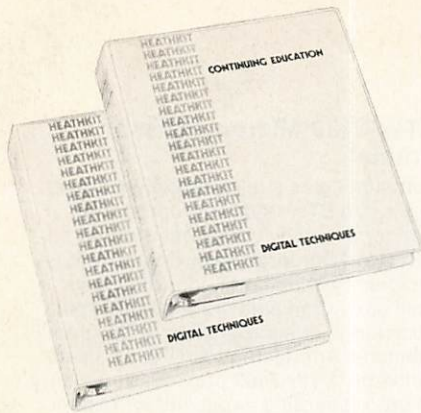
For the DC, AC, Semiconductor and Electronic Circuits courses — helps you perform each experiment quickly and easily. And after you finish the course, it's ideal for "breadboarding" your own design projects. Has solderless breadboarding sockets, 2-range variable sine and square wave (200-20,000 Hz) signal source, dual-variable power supplies for positive

and negative voltages (both variable over 1.2 to 16 volts, 120 mA, both regulated and short-circuit protected), 1k and 100k linear potentiometers. Center tapped transformer provides 30 V rms, 60 Hz for line experiments. For 120 VAC, 60 Hz or 240 VAC, 50 Hz.

811-26/ETW-3100, Shpg. wt. 6 lbs. \$99.95

ETW-3100 SPECIFICATIONS

POWER SUPPLIES: Positive Supply Output: 1.2 to 15 volt DC, continuously variable. Load Regulation: Better than 1%, no load to full load. Current Output: 100 mA with short circuit protection. Negative Supply Output: -1.2 to -15 volts DC, continuously variable. Load Regulation: Better than 1%, no load to full load. Current Output: 100 mA with short circuit protection. **GENERAL:** Power Requirements: 105-130 volts or 210-260 volts RMS, 50-60 Hz, 7 watts maximum. Dimensions: 12 $\frac{1}{2}$ " wide x 11 $\frac{3}{4}$ " deep x 3 $\frac{1}{2}$ " high. Net Weight: 4 lbs.



Digital Techniques

Digital Techniques covers fundamentals and theory; uses; digital logic circuits; digital integrated circuits; Boolean algebra; flip flops and registers; sequential logic circuitry; combinational logic circuitry and digital design. Learn to discuss the advantages of using digital techniques, to convert between binary and decimal number systems and to recognize the binary codes, discuss the operation and applications of binary and BCD counters, shift registers and other sequential logic circuits; use Boolean algebra to express logic operations and minimize logic circuits in design, name the major components used in implementing digital circuits and explain how they operate, explain the operation of flip-flops, design both combinational and sequential logic circuits for a given application from definition and concept to the selection of the integrated circuits and discuss the operation and application of digital counters in time and frequency measurements. Average completion time for Course 5 is 40 hours. A prior knowledge of electronics (such as that covered in our four Basic Electronics Courses) is required but the course can be successfully completed by those with math or science backgrounds. Includes texts, records and 44 electronic components for 24 experiments. The ET-3200 Digital Trainer is required for performing the experiments. Take the optional final exam and a passing grade

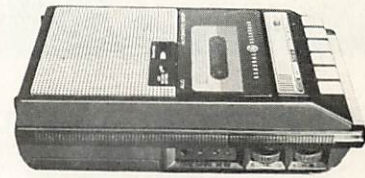
- Comprehensive instruction in the latest digital techniques and design applications to include TTL and microprocessors.
- Introduction: techniques and uses, binary numbers, digital codes.
- Semiconductor Devices for Digital Circuits.
- Digital Logic Circuits: AND gates, OR gates, NAND/NOR logic, etc.
- Digital Integrated Circuits: TTL, ECL, CMOS, NMOS, PMOS, how to choose.
- Boolean Algebra.
- Flip-Flops and Registers: latches, D & JK flip-flops, storage registers, applications.
- Sequential Logic Circuitry: binary, BCD, modulo N, up/down, counters, dividers, shift registers.

of 70% or better earns 4.0 Continuing Education Units and a Certificate of Achievement.

811-26/EE-3201, 9 lbs. \$54.95

811-26/EEA-3201, Optional Cassettes,* 2 lbs. \$6.95

811-26/EWS-3201, EE-3201 plus ETW-3200 Digital Experimenter/Trainer, 22 lbs. \$159.95



Cassette Player/Recorder

Ideal for the Continuing Education Series cassettes, it even lets you record. Has built-in condenser microphone, automatic shutoff, earphone jack, 3-digit counter. Self-storing handle. 3" x 5 7/8" x 10 5/8". 120 VAC/Battery-operated.

811-26/ECP-3801, Shpg. wt. 6 lbs. \$60.00

High output, low noise tapes recommended for above. Pack of three 30-min. cassettes.

811-26/ECP-3802, 1 lb. \$6.00

*Optional Cassettes duplicate materials on records, but in convenient, easy-to-use cassette format.

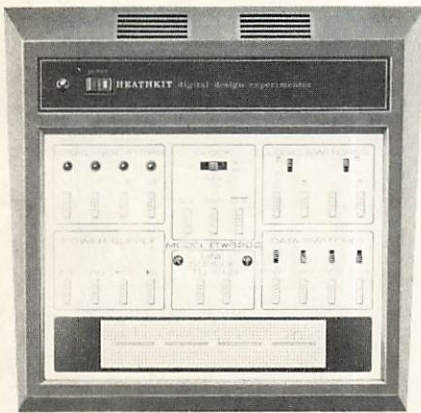
Versatile Digital Trainer

A must addition to your EE-3201 Digital Techniques course. The ETW-3200 Trainer rounds out your education and provides the "hands-on" experience necessary for your proper understanding of digital devices and operations. Use the ETW-3200 to perform all the experiments in the Digital Techniques Course develop projects, build and test prototypes, verify circuit operation and check digital IC's.

Has solderless breadboard sockets for experimentation and design, four binary data switches, 2 "no-bounce" switches to pulse logic circuits, 3-frequency pulse clock generator and 4 LED's for visual

indication of logic states. The ETW-3200 also contains three regulated power supplies with outputs of +12 VDC @ 100 mA, -12 VDC @ 100 mA and +5 VDC @ 500 mA. Each output features current limiting and is overload protected for safe operation. Breadboard sockets accommodate up to eight 14 or 16-pin dual-in-line ICs, also 24, 28, and 40-pin DIPs. The power supplies and circuitry of the ETW-3200 are compatible with most of today's commonly-used integrated circuit logic families including: RTL; DTL; TTL; CMOS; ECL; NMOS; PMOS; Linear. For 120 VAC, 60 Hz.

811-26/ETW-3200, 6 lbs. \$119.95



ETW-3200 SPECIFICATIONS:

DATA SWITCHES: States: +5 volts or 0 volts. Maximum Current: 10 mA, each switch. Outputs: 4 terminals, one for each switch. LOGIC SWITCHES: Type: Momentary contact, spring loaded. Circuit: Two flip-flop latches for contact bounce buffering. Output States: Complementary, +5 volts and +0.2 volts. CLOCK: Output Frequency: 1 Hz, 1 kHz, 100 kHz; ±20%. Duty Cycle: 45%. Output Voltage: 5 volts peak-to-peak. POWER REQUIREMENTS: 105-130 volts or 210-260 volts rms, 50-60 Hz, 15 watts maximum. Fuse: 3/4-ampere, slow-blow. DIMENSIONS: 12 1/8" wide x 11 3/4" deep x 3 1/2" high. NET WEIGHT: 4 lbs.

IMPORTANT NOTE: All the Continuing Education Courses and trainers may qualify for a Federal Tax Deduction. Treasury Regulation 162-5 permits an income tax deduction for educational expenses undertaken to: (1) maintain or improve skills required in one's employment or other trade or business, or (2) meet express requirements of an employer or a law imposed as a condition to retention of employment, job status or rate of compensation.

NOTE: Money back guarantee. We are so sure that you will enjoy and benefit from these courses that if, for any reason, you are dissatisfied, we will refund the full purchase price of the text material less trainer.

HEATH
Schlumberger

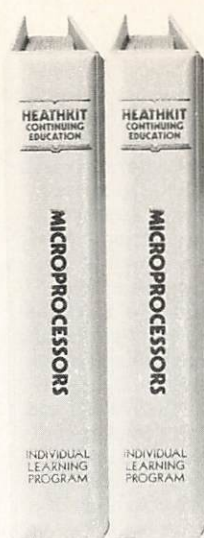
The Fascinating World of Computers



EE-3401 Microprocessor Course

EE-3401 guides you step by step through microprocessor operation to provide you with a thorough understanding of microprocessors. You utilize concise self-study texts to cover: Number Systems and Codes, Microcomputer Basics, Computer Arithmetic, Introduction to Programming, The 6800 Microprocessor, Part I, The 6800 Microprocessor, Part II, Interfacing the Microprocessor, Part I, and Interfacing the Microprocessor, Part II. Colorful audio and visual presentations are combined to further enhance your knowledge of such subjects as programming, designing with microprocessors, and semi-conductor memories.

With the ETW-3400 Microprocessor



EE-3401 Microprocessor Course and Digital Computer/Trainer



Trainer you perform 19 fascinating and informative experiments including: programming and interfacing applications, program branches, arithmetic and logic instructions, address decoding, introduction to the Peripheral Interface Adaptor, and much more. The course comes complete with 62 electronic components including two 2112 256x4 RAM's, 1406 digital-to-analog converter, 741 and 301 op amps and a variety of other microprocessor oriented devices.

Prerequisites are the EE-3201 Digital Techniques Course or equivalent knowledge. 8.0 Continuing Education Units and certificate for passing optional exam.

811-26/EE-3401, 10 lbs. \$89.95

ETW-3400 Microprocessor Trainer

Functioning as a miniature digital computer, the ETW-3400 Microprocessor Trainer perfectly complements your EE-3401 Microprocessor Course and is an ideal training unit upon which you may easily and enjoyably expand your knowledge of microprocessor programming and interfacing techniques. In addition the ETW-3400 provides you plenty of breadboarding capability for experimentation, prototyping and system design.

The ETW-3400 is based on the popular 6800 microprocessor and key features include: A built-in 1K ROM monitor program for controlling unit operation; 6 digit hexadecimal 7 segment LED display for address and data readout; 17 key hexadecimal keyboard for entering programs, data and control of the unit; 256 bytes of random access memory (RAM), expandable to 512 bytes with chips supplied with the EE-3401 course; Breadboarding socket for prototyping interfacing and memory circuits; 8 buffered binary LEDs for display of breadboard logic states; 8 SPST DIP switches for binary input to breadboarded circuits; +5, +12, and -12 VDC power supply outputs.

811-26/ETW-3400, 7 lbs. \$240.00

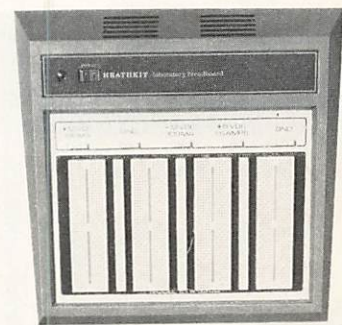
ETW-3300 Lab Breadboard

The ETW-3300 laboratory breadboard makes circuit development simpler. Solderless sockets and built-in power supplies provide easy operation, with no external equipment needed. Has three dual ground and power bus strips. Four breadboarding sockets, each with forty-eight rows of common connection

points. The 3300 accommodates both discrete components and integrated circuits, and the solderless connectors will accept up to No. 20 solid wire. Power supplies include +5 volts @ 1.5 amps and ± 12 volts @ 100 mA; all regulated and short-circuit protected.

811-26/ETW-3300, 6 lbs. \$140.00

ETW-3300 SPECIFICATIONS: OUTPUTS: +5 VDC @ 1.5 amps; +12 VDC @ 100 mA; -12 VDC @ 100 mA. **REGULATION:** Load: Less than 2% variation from no load to full load on all supplies. **CURRENT LIMITING:** Fixed current limiting of each supply at rated current provides short-circuit protection. **POWER REQUIREMENT:** 120/240 VAC 60/50 Hz, 30 watts at full load. **SIZE:** 3 1/2" H x 12" W x 12" D.



BASIC PROGRAMMING SELF-INSTRUCTIONAL COURSE

This course teaches you how to program your computer using the popular BASIC language. BASIC (Beginner's All-Purpose Symbolic Instruction Code) is essential for hobby and personal computing; it is also widely used in education and business. The course covers all formats, commands, statements and procedures plus the creative aspects of computer programming, so you can make practical use of it in solving problems and creating your own unique programs. Like our other self-instruc-

tional courses, it uses programmed instructions backed by practical hands-on computer experiments and demonstrations to reinforce and personalize the text material. Passing an optional final exam earns you a Certificate of Achievement and 3.0 Continuing Education Units. While the BASIC course is keyed to Heathkit computers, it is also equally applicable to any computer system using BASIC.

811-26/EC-1100, 7 lbs. \$29.95



Heath/Schlumberger...Pioneers In Value-Proven Instrumentation

EXPERT DESIGN

Heath/Schlumberger engineers know the problems encountered "in-the-field," and they design instruments to solve those problems accurately. Whether you need testers, single or dual trace scopes, counters, timers, recorders or power supplies, you can depend on Heath/Schlumberger to bring you the precision instrument you need for the job.

30-DAY TRIAL

Manufacturers, schools, design labs, etc. can take advantage of our 30-day FREE trial plan. Simply send us a purchase order stipulating you would like a 30-day trial. After credit review, the instrument will be shipped to you. Use it for 30 days in your lab. If, for any reason, the instrument is not suitable for your application, return it to us. You pay shipping costs only. Heath/Schlumberger instruments help you do the job better.

SPECIFICATIONS AND FEATURES

Features we include are, in many cases, extra-cost options with others. For example, our strip chart recorders include remote programming capability, electric pen lift, pushbutton paper advance, even rack mount hardware and metric conversion instructions. Our instruments are ready to use, and we offer a complete line of probes and cables for added versatility.

MANUAL PREVIEW

If you're interested in a particular instrument, and want to know if it

Today, Heath Company, with its 480,000 sq. ft. home plant on the shores of Lake Michigan near Benton Harbor, is the world's largest producer of electronic kits. There are other outlets in Canada, the United Kingdom and Europe, and Heathkit Electronic Center service facilities in nearly every corner of the globe.

The Heath commitment to quality is evident in all Heath/Schlumberger instruments. All instruments give you the specifications, versatility, adaptability and dependability you need to do the job right.

will fit your needs, the best way to find out is to order the manual. You can look over the operation and service procedures, check out the schematic and specs, and it will show you why Heath/Schlumberger instruments are your best buy. Manuals for all instruments are only \$3.00. And, of course the cost of the manual is deducted from the purchase price when you buy the instrument.

SERVICE

Each Heath/Schlumberger instrument is built to the highest quality standards, and backed by a complete service facility. Specifications for Heath/Schlumberger instruments are guaranteed for a period of one year (see warranty). If an instrument doesn't meet specs, send it back and we'll make it right. Service is available through the factory, through Heathkit Electronic Centers nationwide and through many overseas locations. (See back cover for the location nearest you.) Just one more reason you can buy Heath/Schlumberger products with complete confidence.

QUANTITY DISCOUNT

If you intend to use many of the same instrument models, quantity discounts are available. For information on specific requirements, contact Heath/Schlumberger Instruments, Benton Harbor, Michigan 49022; phone (616)-982-3411.

CONTRACT SALES

Inquiries or requests for quotations of 250 or more of any product should be directed to our Contract

Sales Department. Arrangements can be made for custom packaging private labeling and/or design modifications to meet your specific needs. Phone or write directly to: Heath Company, Contract Sales Department, Benton Harbor, Michigan 49022; phone (616) 982-3519.

In many locations in the U.S. and around the world, Heath/Schlumberger products are available from leading distributors of electronic products or educational and training systems. In addition to Heath/Schlumberger products, these area distributors can provide a single, convenient source of many related products and services.

Heath/Schlumberger One Year Full Warranty*

For a period of one year after purchase, Heath Company will replace or repair free of charge any product that is defective either in materials or workmanship. We warrant that during the first full year after purchase, our products, when used in accordance with our printed instructions, will meet published specifications.

If your Heath factory-assembled product malfunctions or fails to operate at any time during the warranty period, through no fault of yours, we will service it free upon proof of purchase and delivery at your expense to the Heath factory, or any Heathkit Electronic Center (units of Schlumberger Products Corporation), or any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the use of your Heath product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty does not cover and we are not responsible for damage caused by misuse or fire or unauthorized modifications to or uses of our products for purposes other than advertised. Our warranty does not include reimbursement for customer assembly or set-up time.

This warranty covers only Heath assembled products and is not extended to allied equipment or components used in conjunction with these products. We are not responsible for incidental or consequential damages. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

*Does not apply to KD11F CPU board in WH-11. This item is warranted for 90 days only.



Heathkit Electronic Centers:

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