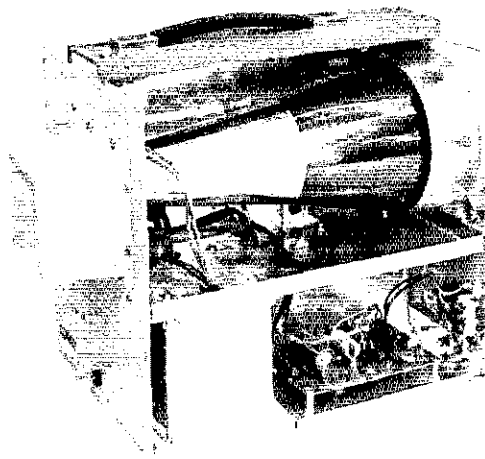


interior view of the IO-102 scope. The vertical amplifier of Fig. 2 is assembled on the pc board at the lower right in the photograph. The heavy-gauge metal box at the lower left houses the power transformer, thus keeping stray ac fields away from the rest of the circuit.



Additional features are regulated voltages to all amplifiers, and careful shielding of the power supply to prevent unwanted ac from being coupled into the remainder of the circuit.

Construction of the oscilloscope was without incident. The manual is complete, instructions are concise, and are rendered in plain language. Assembly time was 10-1/2 hours from start to finish. Alignment and checkout required an additional hour of time. Not bad, indeed, for a relatively "busy" test-instrument circuit! One reason for the rapidity with which one can assemble this kit is that it is built on boards, four in all. The unit uses 30 transistors and 31 diodes. The only tube employed is the CRT.

A block diagram of the scope is given in Fig. 1. The vertical amplifier is illustrated schematically in Fig. 2. Field-effect transistors are used in the early stages of both the horizontal and vertical amplifiers. The circuits of both amplifiers are quite similar, except, of course, there is no attenuator at the input of the horizontal amplifier.

The outward appearance of the test instrument is as professional as is the interior. Those remembering the early day Heath scope kits in this price class will find it difficult to believe that the IO-102 was engineered by the same manufacturer. Gone is the somewhat flimsy cabinetry, the ac ripple found (all too often) on the displayed waveform, and the rather blasé front-panel decor. Furthermore, this scope feels like there is something inside the cabinet other than a handful of tubes and a lot of unused space. Despite the compactness of this scope, it's a heavy little fellow.

Pages 69 through 74 of the assembly manual contain a down-to-earth short course on the use of an oscilloscope. Data are given on checking audio wave forms for linearity and distortion. A section

is provided which shows how to troubleshoot TV receivers with a scope, emphasis being placed on signal tracing. Information is provided on using the scope for receiver alignment and the measurement of ac and dc voltages. There is a section which deals with frequency measurement with the IO-102, and phase measurement is discussed at the end of the presentation. Various significant wave forms are illustrated in the text, thus providing the less-experienced amateur with clues as to what he should look for when analyzing a circuit. —
WICER

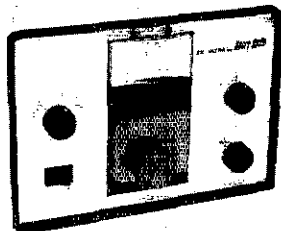
Heathkit Model IO-102 Oscilloscope

Dimensions (HWD) and Weight:
12-3/4 × 9-1/4 × 16-1/4 inches, 27 pounds.
Power Requirements: 110-130 V ac or 220-260 V ac (50-60 Hz).
Power Consumption: 70 watts.
Price Class: \$120.
Manufacturer: Heath Company, Benton Harbor, MI 49022.

QST ——— QST ——— QST

The Henry Radio 2K Ultra Amplifier

IF ONE WORD were used to describe the Henry 2K Ultra, that word would be *unique*. This is the first two-kilowatt amplifier marketed for amateur use employing conductively cooled tubes. The Ultra is designed for continuous operation: It is rated at 2000-watts PEP input for ssb service and 1000-watts input for cw and RTTY in the amateur bands between 3.5 and 30 MHz. A-m operation is not recommended. The drive requirement to produce the rated final-amplifier input is only 75 watts.



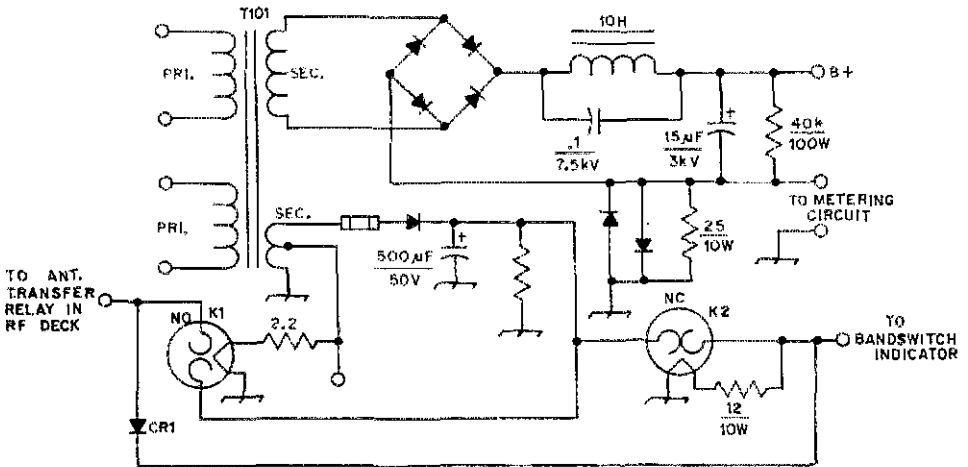


Fig. 1 - Partial circuit diagram for the 2K Ultra power supply. The power transformer may be connected for either 117-V ac or 220-V ac operation. The functions of K1 and K2 are described in the text.

The 8873

The heart of the 2K Ultra is a pair of 8873 conductively cooled triodes. These tubes have a plate dissipation of 15 watts each, but with the addition of a heat sink, the power dissipation capability increases to 400 watts. Actually this is a nominal figure, Eimac states that plate dissipation is limited only by the efficiency of the heat sink. The anode and base-seal temperatures must not exceed 250°C. Henry Radio uses a small blower to circulate air past the heat sink during long periods of key-down service. The blower operates whenever the temperature of the heat sink rises above 210°C and is wired to function even after the amplifier is turned off. With the amplifier tuned

for 1-kW input, the blower activates after the key is depressed continuously for twelve minutes!. Since the blower normally is not used (except for the most severe operating conditions) the amplifier produces no mechanical noise.

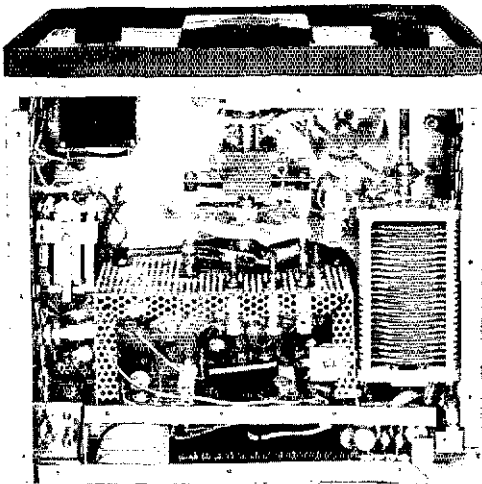
Of particular interest is the thermal link used between the 8873 anodes and the heat sink. It is made from beryllium oxide (BeO) which has heat-conducting properties of aluminum while maintaining high electrical resistance. Thermal compound is used to form a heat-conducting bond between the tube anodes, the BeO link, and the heat sink.

The 8873 has an indirectly heated cathode which requires that heater voltage be applied for one minute before full cathode emission can be attained. A 60-second delay relay prohibits the amplifier from being driven during the warm-up period. Heater voltage is obtained from a separate 6.3-volt secondary winding on the plate transformer. To prevent exceeding the rated heater-to-cathode voltage, excitation is applied to both the cathode and heater of each tube. A bifilar-wound choke keeps the heater above rf ground.

A five-section hand switch performs all of the switching functions. The first section controls the indicator lights on the front panel. The second and third sections provide the appropriate taps for the output network. The fourth and fifth wafers select the proper input inductors.

Input and Output Circuits

The 2K Ultra uses a tuned-input circuit which reduces both intermodulation distortion and drive requirements. A broad-band L network is used for



A look into the Ultra shows the L section of the pi-L output circuit. The input circuits are located in the perforated box. The blower is mounted to the bottom cover and is not shown in the photograph.

Interior view of the amplifier. The 8873 heat sink is mounted to the back of the cabinet. Next to it is the directional power meter. The beryllium-oxide thermal link conducts heat away from the tubes. The plate choke is located above the main-tuning capacitor and the multimeter switch is at the lower right.

an input circuit on 10 meters. Pi networks are used on the 40-, 20- and 15-meter bands. Two band-switch positions are employed to cover 3.5 to 4 MHz. The input impedance is 52 ohms.

A pi-L output circuit enables the amplifier to operate efficiently on either ssb or cw without a need for changing the plate voltage. The pi-L network matches a wide range of plate load impedances. It also has the advantage of enhancing harmonic suppression. The amplifier output impedance is 52 ohms, unbalanced. The SWR should not exceed 2:1.

Tuning the amplifier is accomplished quickly by observing the tuning meter located above the large multimeter while making the adjustments. This zero-center meter monitors the current in a bridge circuit consisting of the amplifier tubes and several diodes. When the circuit is balanced, the tubes are operating into the optimum load impedance for ssb and the meter reads zero (marked SSB in the center of the meter scale). For cw operation, the amplifier is tuned so that the meter needle swings left of the ssb position. Rf-output power as well as reflected power are monitored by the large panel meter. When the amplifier is tuned properly as indicated by the small tuning meter, peak output can be confirmed on the large meter, and the drive can be adjusted for any power input up to the legal limit.

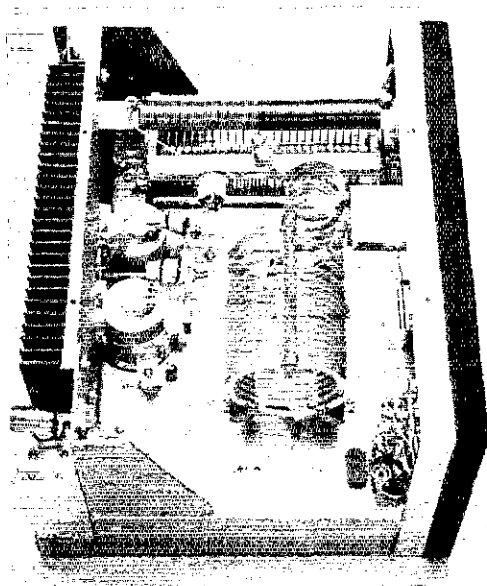
The tuning and loading capacitors each have a reduction drive to make adjustments easier. Approximate band settings are marked on the panel corresponding in color to the band indicator lights.

Power Supply

The power supply delivers 2200 volts under full load and is rated for continuous duty. It is equipped with a handle which makes the supply quite easy to move (considering it weighs 61 pounds!).

A full-wave bridge rectification circuit with a choke-input filter provides the operating high

The power supply for the Ultra is connected to the rf deck by a twelve-conductor cable. A full-wave bridge circuit with a choke-input filter is used. The power transformer supplies all voltages to the amplifier. The filter choke is mounted next to the diode heat sink under the resistors. Both time-delay relays are shown at the upper left. The small capacitor on the right side is used in conjunction with the filter choke to improve regulation and filtering.



voltage. The 15- μF filter capacitor is rated at 3000 volts. A 0.1- μF , 7500-volt capacitor is connected in parallel with the filter choke, as shown in Fig. 1. This tuned-choke system is a very effective circuit to provide excellent voltage regulation while improving the filtering during low-current load conditions. Transient suppression is assured by a Thyrector assembly wired across the primary of the transformer.

Two thermally activated relays are used to provide a time-delay function for warm-up and a visual indication of when the amplifier is ready for operation; see Fig. 1. K1 is connected to the filament winding of the power transformer. When primary power is supplied to the transformer, the relay filament begins to heat. At the end of one minute, the filament has heated sufficiently to cause the normally open contacts contained within the relay tube envelope to close. This action allows a dc voltage to appear at the antenna relay so that

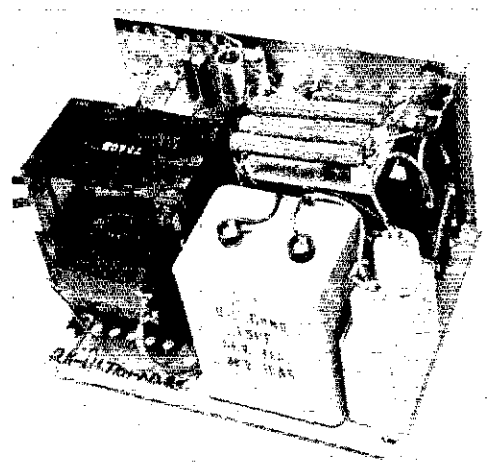
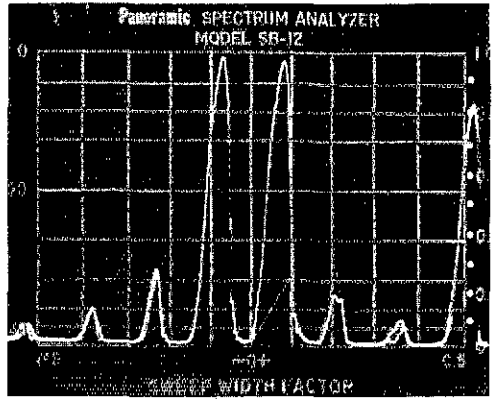


Fig. 2 - Spectral analysis of the 2K Ultra under two-tone test conditions. The third-order distortion products are 34 dB below the output. (The Panoramic scale is calibrated in dB below a single tone. To convert this scale for a two-tone test, subtract 6 dB from the figures indicated at the left side of the scale.)



the amplifier may be activated by means of the exciter VOX control. During the one-minute period before K1 closes, the rf deck indicator lamps receive an intermittent voltage from K2. The thermally operated contacts of K2 open within a short period after voltage is applied, interrupting the relay filament circuit. The contacts then close and the cycle repeats. This low-frequency oscillator is used to provide a flashing indicator on the amplifier front panel. When K1 closes, however, the front-panel indicator lamps receive a continuous voltage directly from the low-voltage line via CR1.

Some Final Comments

The author received many compliments about the clean sounding signal of the Ultra. Fig. 2 is a panoramic display of the third- and fifth-order distortion products. No TVI was noticed at the author's QTH. The 2K Ultra is a very rugged unit. It can be easily overdriven, however, if the a/c is not adjusted properly. Excessive grid current will seriously shorten tube life. The replacement cost of the 8873 is comparable to that of a 3-500Z: under forty dollars. - *W0DRE/1*

The Henry Radio 2K Ultra Amplifier

Dimensions (HWD) and Weight:

(RF deck) 8-3/4 x 12 x 11 inches, 20 pounds; (Power supply) 7-1/2 x 12-1/2 x 10-1/2 inches, 61 pounds.

Power Requirements: 220 V ac, 50/60 Hz, 15 A or 117 V ac, 50/60 Hz, 30 A.

Price Class: \$850 including tubes and power supply.

Manufacturer: Henry Radio, Inc., Los Angeles, CA 90064.

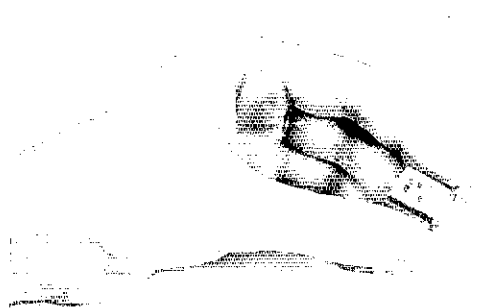
• New Apparatus

A New 10.7-MHz Filter for Fm Receivers

Builders of amateur fm receivers should be interested in this new product by Spectrum International, the XM 107S04 crystal filter. This component is suitable for use in the i-f circuit of a single-conversion receiver, or it can be used in double-conversion receivers that employ a 10.7-MHz first i-f.

The filter is relatively small in size, measuring approximately 0.721 x 0.75 x 0.316 inches. An especially interesting feature is its package style. An HC-6/U-type crystal case, such as used for transmitting and receiving crystals, is used to house the four-pole filter. The assembly is equipped with two small pins which can be made to fit into a standard crystal socket. A metal clip is welded to one side of the case, and is used for connection to the ground bus in the circuit.

The XM 107S04 is designed for narrow-band use. A band width of ±7 kHz is characteristic at the -6 dB points of the filter's passband. At 40-dB-down points the band width is ±21 kHz. Insertion loss is rated at 3 dB, and ripple is 1 dB maximum. The filter is bilateral, and has an



impedance of 910 ohms with 35 pF of capacitance in parallel with each port.

The filter is the most recent product developed by Schilling of West Germany, and is available from Spectrum International, P. O. Box 87, Topsfield, MA 01983, \$15.95 in single lots. - *WICER*.