



73 Tests

The Electrotone M-100 Gate Modulator

Charles E. Spitz W4API
1420 S. Randolph St.
Arlington 4, Virginia

IF you are the average ham, or more active than average, you may have passed this unit by without thinking too much about it filling a place in your hamshack. After all you may have everything. Well, *almost everything!* I admit seeing the advertisement in the November issue of 73, but since it talked mainly about commercial or home brew CW transmitters, and having no such plans at the time, my curiosity was not sufficiently aroused. Actually, there are many more applications for the M-100 around the average shack than the advertisement implied, whether as a part of the main transmitter or as an adjunct to other projects.

This is a completely self-contained audio system from mike input to modulator output with internal power supply, weighing only five and one half pounds in a compact cabinet about 5x6x7 plus in size, and containing clipping, filtering, over-modulation insurance, carrier control and even a 1000 cycle audio generator to take care of the whistlers!

Since the M-100 is designed to be inserted electrically in your amplifier screen, it obviously is limited to applications where screen grid tubes are used, and where a screen voltage of 400 or less would apply. This is not much of a hardship, since screen grid tubes are the most commonly used in transmitters and amplifiers. There is nothing tricky or difficult in hooking up the unit or operating it.

Of course your transmitter must have the stability which is required of all good phone operation. Although CW needs stability too, defects show up more readily when any rig is modulated. Everyone on phone should occasionally turn on a bfo just to see how many rigs are wobulating while modulating!

There is nothing in the M-100 which of itself would cause such untoward effects, and in fact there is a distinct advantage in it's

Application: To modulate CW transmitters or linear amplifiers. Used with Tetrodes or pentodes, single, parallel or push-pull in the range from 10 to 1000 watts, where 400 volts or less is required for the screen.

Size: 6 1/2" x 7 1/2" x 5 1/4"

Weight: 5 1/2 lbs

Power: 115/230, 50/60 cy, 30 watts

Input: Crystal or dynamic mike

Bandpass: 300-4000 cycles

Tone: 1000 cycle generator

Limiting: Speech clipping, negative and positive peak over-modulation prevention

Output: 400 peak dc volts maximum, 40 ma instantaneous dc current

Guarantee: Two years including replacement of parts and labor; tubes for 6 months

Net Price: \$49.95, delivered in U. S.

Manufacturer: Electrotone Laboratories, 2717 North Ashland Ave., Chicago 14, Illinois

Controls: On-Off Switch, Modulation Level Control, Carrier Level Control, Tone Generator Switch, CW-Phone Switch

low power requirement even when modulating a high power transmitter due to the absence of line voltage fluctuation caused by high level class B modulators reacting on a VFO.

The series gate modulator system was described in the November 1, 1957 issue of Electronics, and in the R.S.G.B. Bulletin of May 1959. The manufacturer also publishes an excellent brochure giving a detailed technical description of the circuit operation, for which he should be commended, and which is available to all who write.

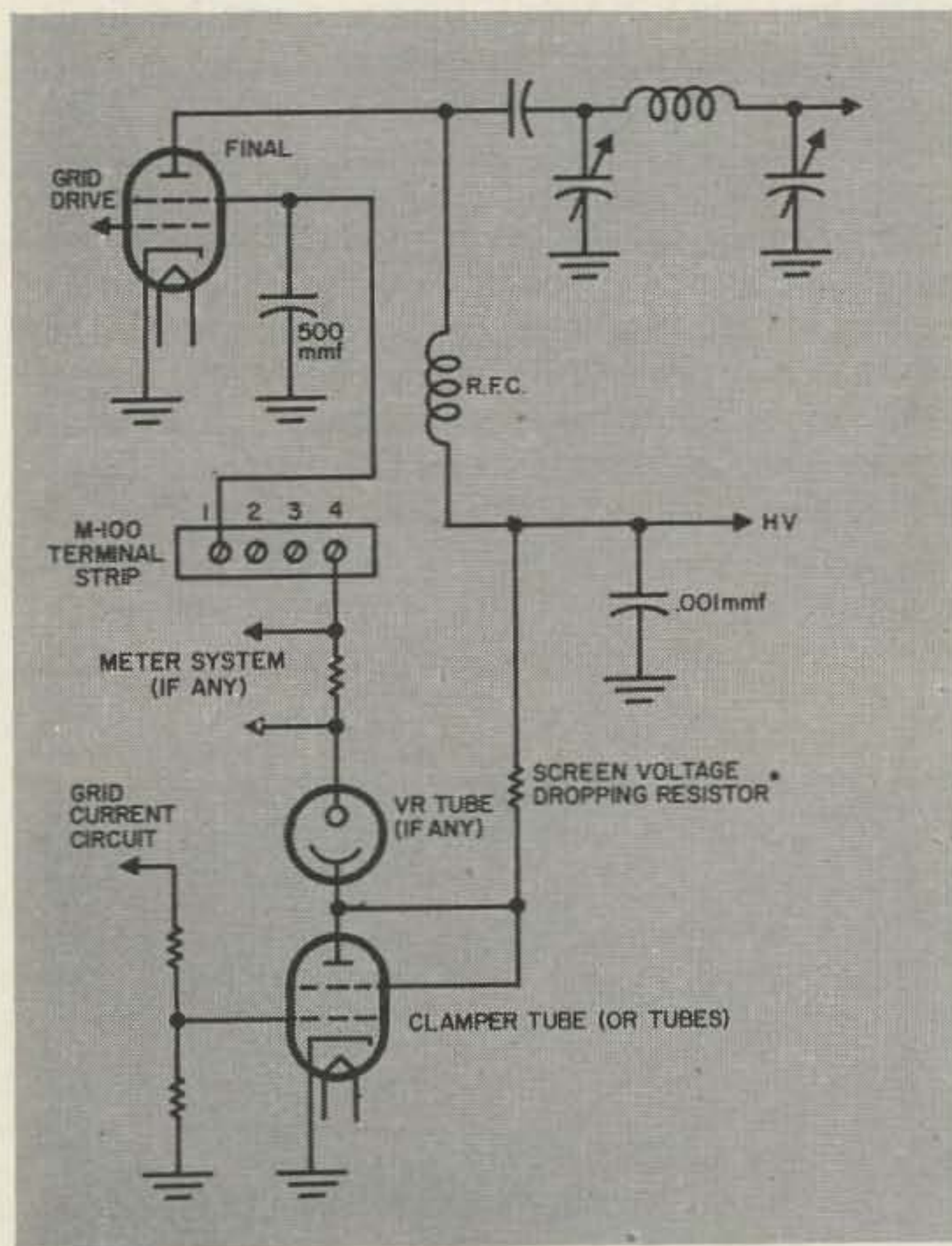


Fig. 2

Note the schematic diagram in Fig. 1. The operation is best stated in terms of dc and ac state consideration. For the dc state, if the grid of V-3A is biased to the cut off point, then the full B plus potential appears on the plate and is direct-coupled to the grid of V-3B. V-3B conducts fully and the voltage drop across the cathode resistor R-15 is applied to the final's screen. Hence, a full rf carrier is obtained. As the slider of the carrier control potentiometer is moved towards the cathode side of V-3A, the bias on the grid diminishes and V-3A starts to conduct, resulting in a voltage drop across its plate load resistor R-14. The reduced voltage appears on the grid of V-3B and reduces the plate current of V-3B proportionately. Hence, the positive potential applied to the final's screen is reduced and rf carrier level is low.

In considering the ac state, with the bias on the grid of V-3A set by the carrier level control to approximately 1 volt negative, the dc

(Turn to page 22)

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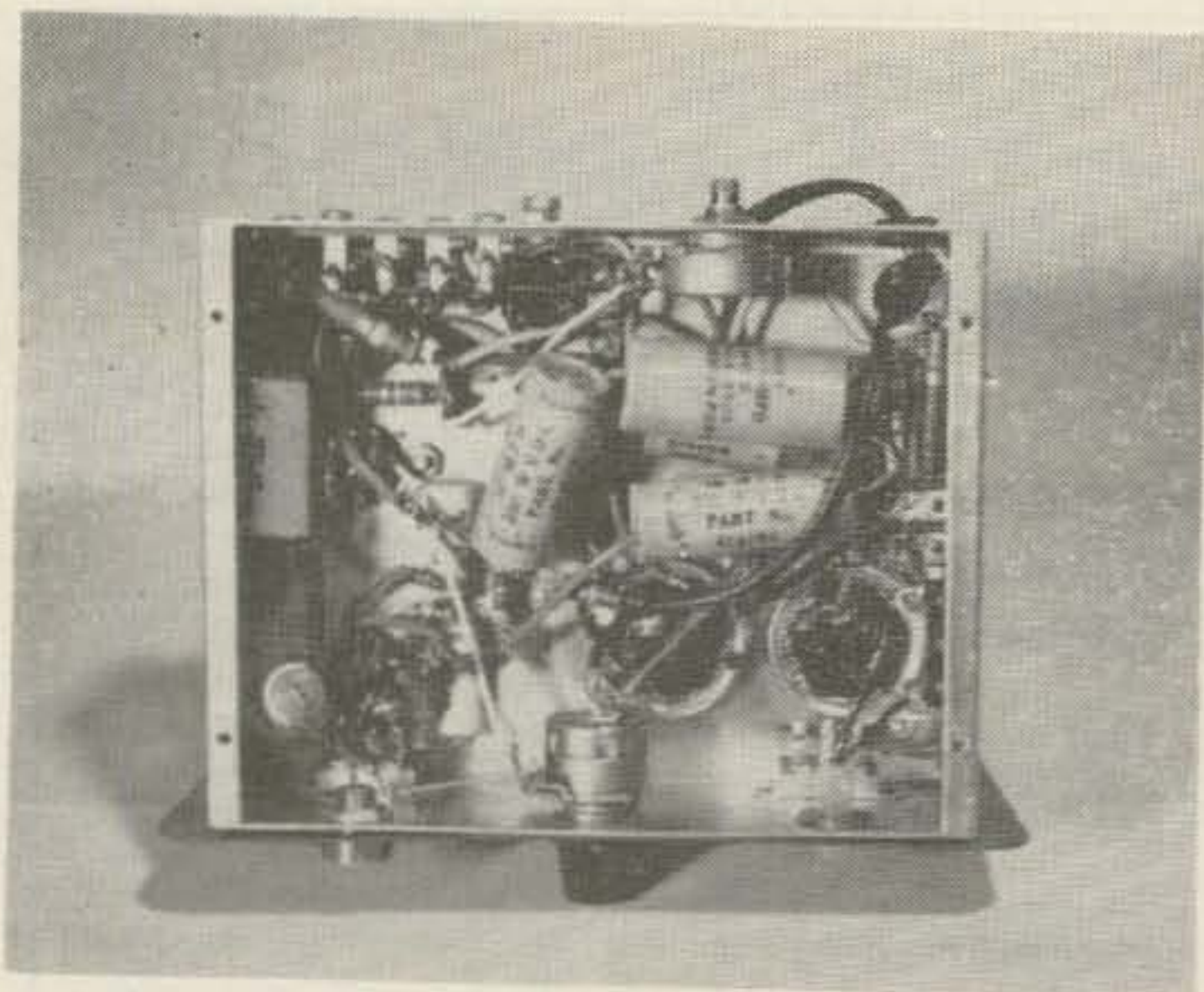
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voltage applied to the final's screen is low, and therefore the rf output is low. If an audio voltage of 1 volt peak is now applied from V-2 to the grid of V-3A, it will be amplified by V-3A and appear through V-3B at the screen of the final and will modulate the low rf output approximately 95%. The mean dc potential of the final's screen remains constant. If the audio voltage applied to V-3A is increased, grid current will flow in V-3A. A negative charge will build up on C-9 proportionately to the peak amplitude of the applied

audio. This additional dc bias applied to the grid of V-3A will cause the potential on the plate of V-3A and the grid of V-3B to rise. The mean screen potential of the final will rise too, resulting in increased rf output.

The increased audio voltage at the grid of V-3A will appear as an amplified voltage at the final's screen relative to its previous level, but as the mean screen potential has also been raised the rf carrier is again modulated approximately 95% and no over-modulation occurs.

The bias on V-3A will increase until a limiting condition is reached where the bias built up on the coupling capacitor C-9 cuts off V-3A. No further audio voltage can reach the final's screen, the dc potential of which is at maximum; thus positive over-modulation is prevented. Negative peak over-modulation is prevented because the dc screen potential of the final can never fall below the level selected by the carrier control potentiometer; the audio voltage can only modulate this screen dc potential to produce full modulation.

Effective speech clipping is obtained by increasing the audio voltage input above the level that will produce approximately 95%

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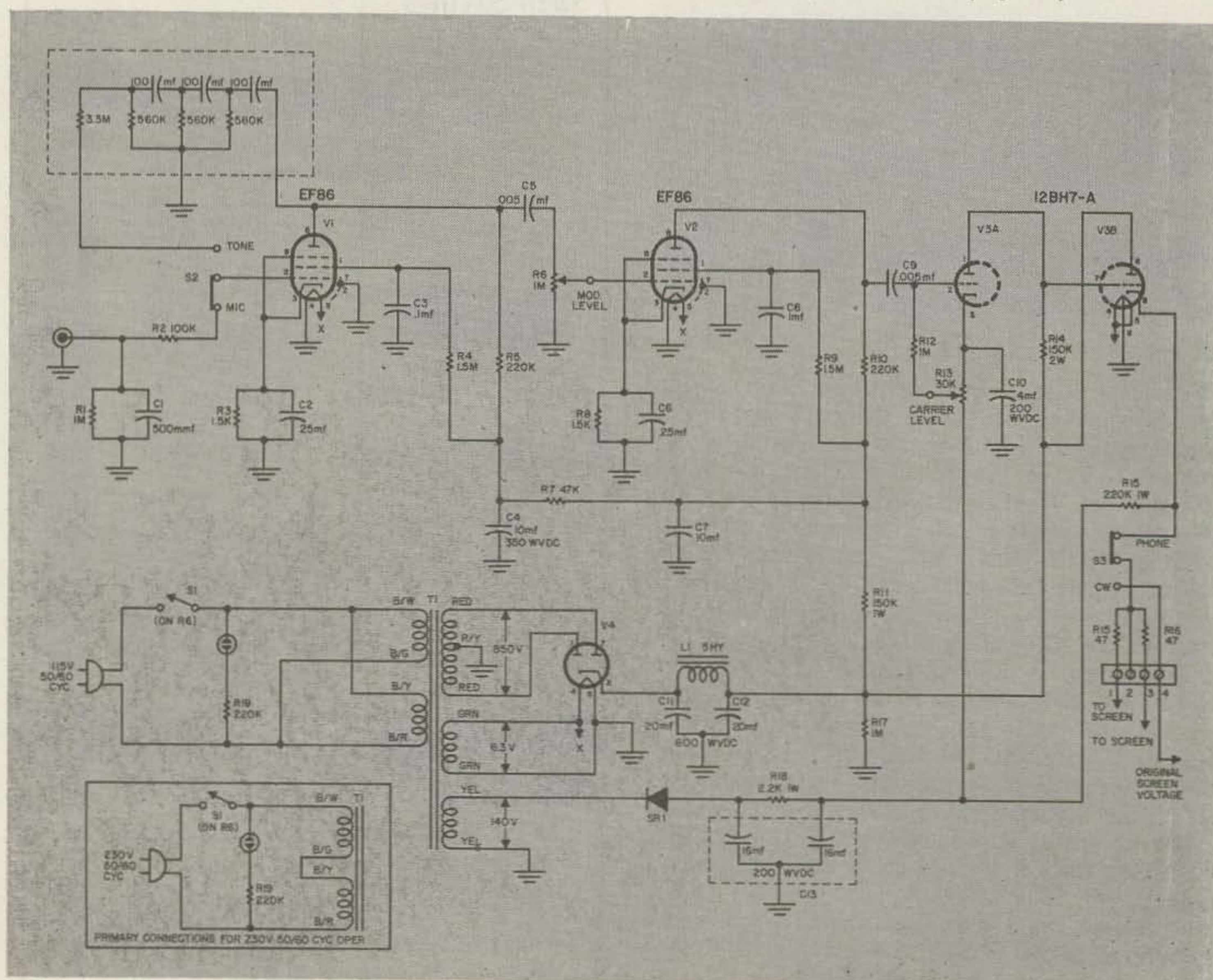


Fig. 1

(M-100 from page 22)

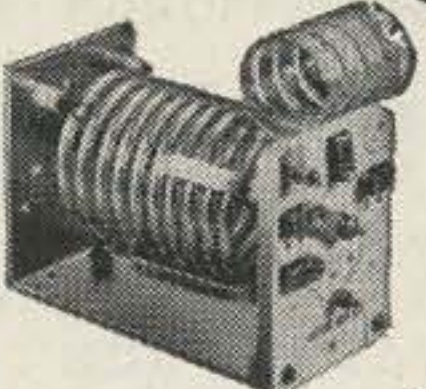
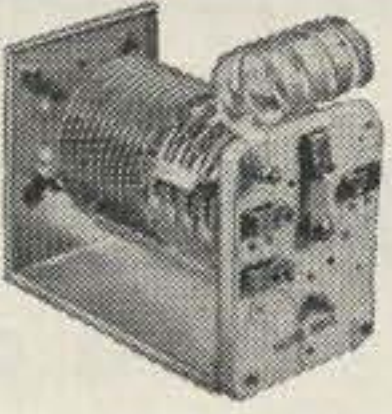
modulation of the full rf output. However, for best speech quality the modulation level should be set no greater than where the transmitter's plate current meter shows an apparent saturation point and further advancement of the modulation control does not increase the plate current. Because no reactive components appear in the modulator after clipping and because the dc coupling between V-3A to V-3B no filter is needed. The low output impedance of V-3B is in keeping with current practices in order to maintain good waveform and modulation linearity.

There are two typical situations in which the M-100 is applied. One is the clamped or regulated screen final amplifier operating in class C, which is illustrated by schematic diagram in Fig. 2, and the other grounded grid amplifiers using beam tetrodes or pentodes. In the case of the latter, efficiency would be greater through the use of the M-100 for screen modulation than with the grid modulated method commonly used. The manufacturer offers to consult with prospective users where they may have a problem concerning connection to and operation of their equipment.

In addition to tests made with home brew equipment, the M-100 was connected to a Viking Navigator which was kindly lent for that purpose by Chuck of Key Electronics in Arlington, Virginia, in order to try it out with a typical commercially designed rig in the hands of many Novices, as well as old timers, and to whom eventual conversion to phone would appeal.

(Now go to page 50)

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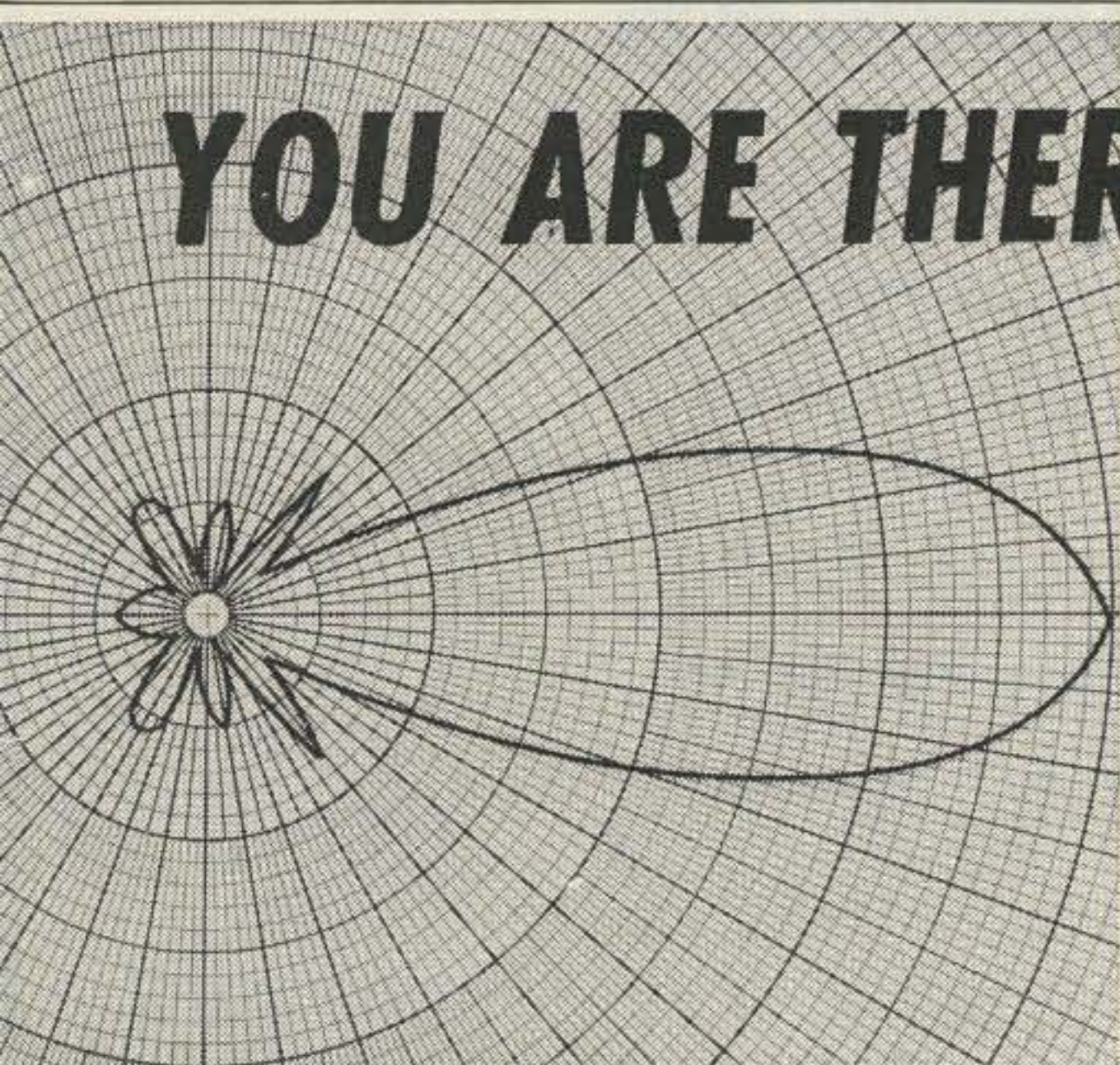
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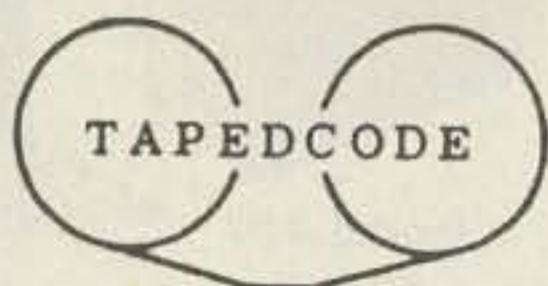
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(M-100 from page 49)

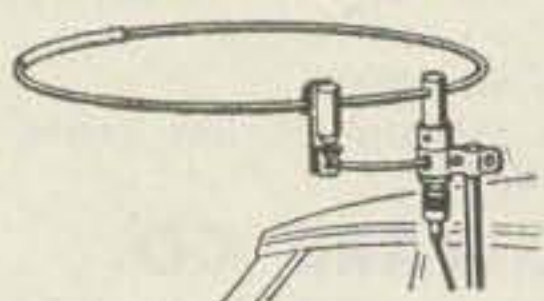
Step-by-step instructions for the hookup are
furnished with the M-100. The only physical
change of note is to insure the screen by-pass
does not exceed 500 mmf and to replace it with
one of that value where it does, as well as to
open the screen dc lead at the socket, bringing
these two connections to the M-100.

When on transmitter standby (receive) or
tune positions, the audio from the loudspeaker
would drive the screen of the transmitter
through microphone pickup. This was cured
by using a pair of auxiliary contacts of the
antenna relay in series with terminal 4 of the
M-100 so that this circuit is open on receive
and closed on transmit.

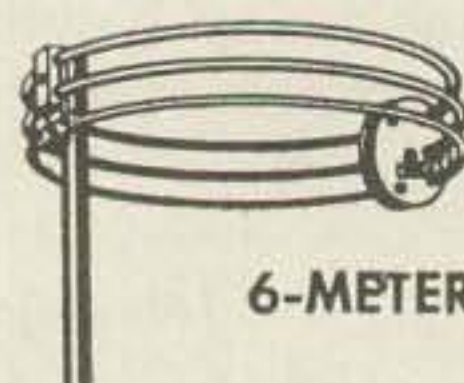
The spectrum around the carrier when
modulating was observed on a Panadaptor and
looked clean at all settings on several bands.
The modulation patterns were checked with a
Central Electronics Multiphase RF Analyzer,
and as may be expected, more precise adjust-
ments of carrier and modulated envelope could
be made. This is true of any modulated system.
'Scope monitoring of phone transmissions
would clean up much of the smog of amateur
radio, were it required by regulation. There
was no difficulty in obtaining patterns equal
to the perfect ones shown in the handbooks.
If you do have or can borrow an oscilloscope

(Turn to page 52)

Watch for the Ashby "Abe Lincoln" Antenna by Hi-Par



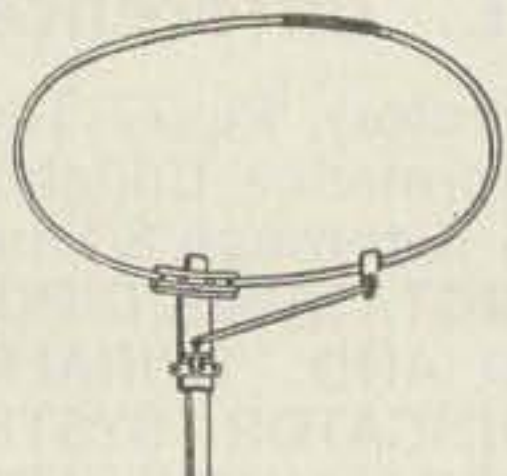
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(M-100 from page 50)
or RF Analyzer, by all means do it. The attachment is very simple and observation educational. With the Multiphase, it is preferable to use its 1000 cycle tone fed to the microphone input in order to obtain sync. The .02 volt output should be used as higher levels would cause distortion due to the high gain of the M-100. Once the best settings for carrier and modulation is found, they remained constant for the microphone and plate current settings of the transmitter.

If you have no means of getting to a scope, satisfactory results can be obtained by following the operation instructions which come with the unit. There is a tendency to turn the gain up too high, therefore a critical on-the-air check is necessary in order to reach maximum clarity with maximum punch. Actually the M-100 hooks up much faster than it takes to talk about it, taking only about twenty minutes with the Navigator.

All on-the-air reports were good, even through heavy QRM on 20 meters in the evening, and most hams were surprised at the low power used while running the Navigator.

The brochure speaks of mobile use as a feature, and the M-100 would be ideal to modulate a high power mobile transmitter. It would be my preference to use a transistorized supply with a 115 volt 60 cycle output such as the Heath MP-10, which, while larger than necessary for the M-100 requirement of 30 watts,

could also operate a station receiver giving you a quick conversion from shack to mobile, and vice-versa.

The self-contained 1000 cycle tone source gives you ICW capability on UHF, as well as the tune-up source for double sideband suppressed carrier should the unit be reworked for that purpose. The bandpass was checked with a Supreme Model 563 Audio Oscillator, maintaining metered constant output and was in close agreement with the 300 to 4000 cycle range, having a sharper cutoff on the lower frequency side where 60 cycle hum troubles originate.

The general impression gained from operation of the M-100 is that it can find a place in almost any ham shack either as part of the main rig, for portable use or as the modulating source for anything you home brew or test. Many of the features available in the unit are those you would like to have but would not have the patience to incorporate in gear assembled for trial or test purposes.

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