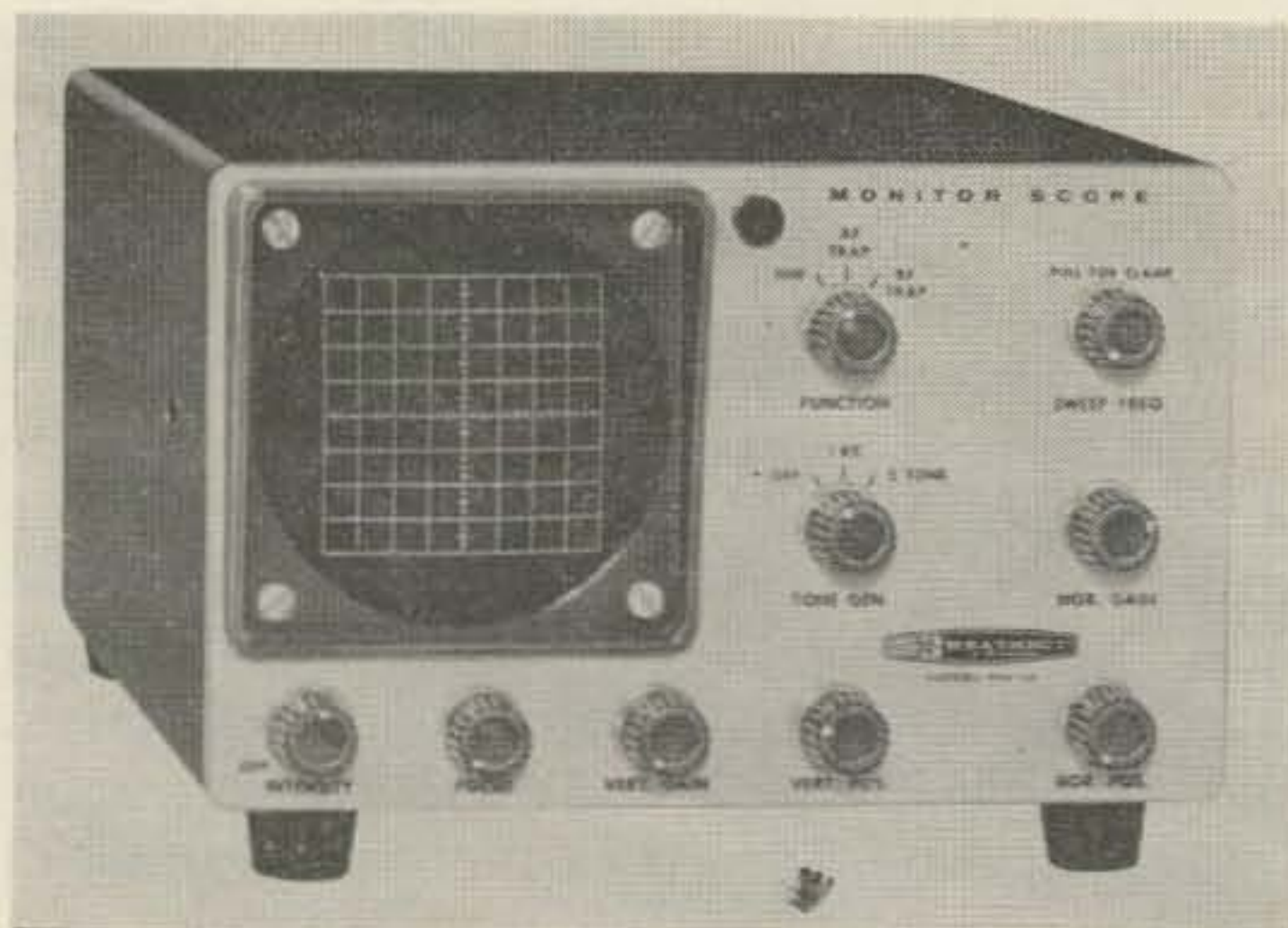




73 Tests The Heath HO-10

The Heath HO-10 Monitor Scope is a welcome addition to the ever-expanding variety of amateur equipment available in kit form. This compact little handful of instrument contains a full 3" tube and is packed with all the features required for adequate monitoring and detailed analysis of both transmitted and received signals. The price of this unit, \$59.95 in kit form, is remarkably low for the features provided. Ready availability of this instrument, at a price most amateurs can afford, should do much toward cleaning up some of the signals that infest our crowded bands.

While the value of a scope in adjusting AM and SSB transmitters is well known to most amateurs, the instrument is not as widely used as it should be. There are several reasons for this. It is often difficult to justify the purchase of the relatively complex and expensive general purpose scope to perform the relatively simple functions required of a monitor scope. An out-board audio oscillator, or oscillators, is required for thorough testing. The resulting test lash-up is usually so complex that it is only used for initial testing and adjustment. The HO-10 Monitor Scope combines these specialized functions in a compact instrument that may be left permanently connected in the station wiring.

While the specifications show all the details, several features, some of which are not included in competitive products, are worthy of special mention. Two audio oscillators are provided for both single frequency and 2-tone

test of the transmitter. A full-fledged, adjustable frequency, horizontal sweep generator is provided along with both horizontal and vertical deflection amplifiers. Provision of a demodulator for rf trapezoid measurements, an rf attenuator and a beam clamp circuit are other design highlights. While these features are impressive, the true utility of the instrument is achieved by a switching system that functionally integrates them to best meet the specialized requirements of amateur station monitor service.

All inputs appear on the rear of the instrument and it may be permanently connected for the type of display desired in normal oper-

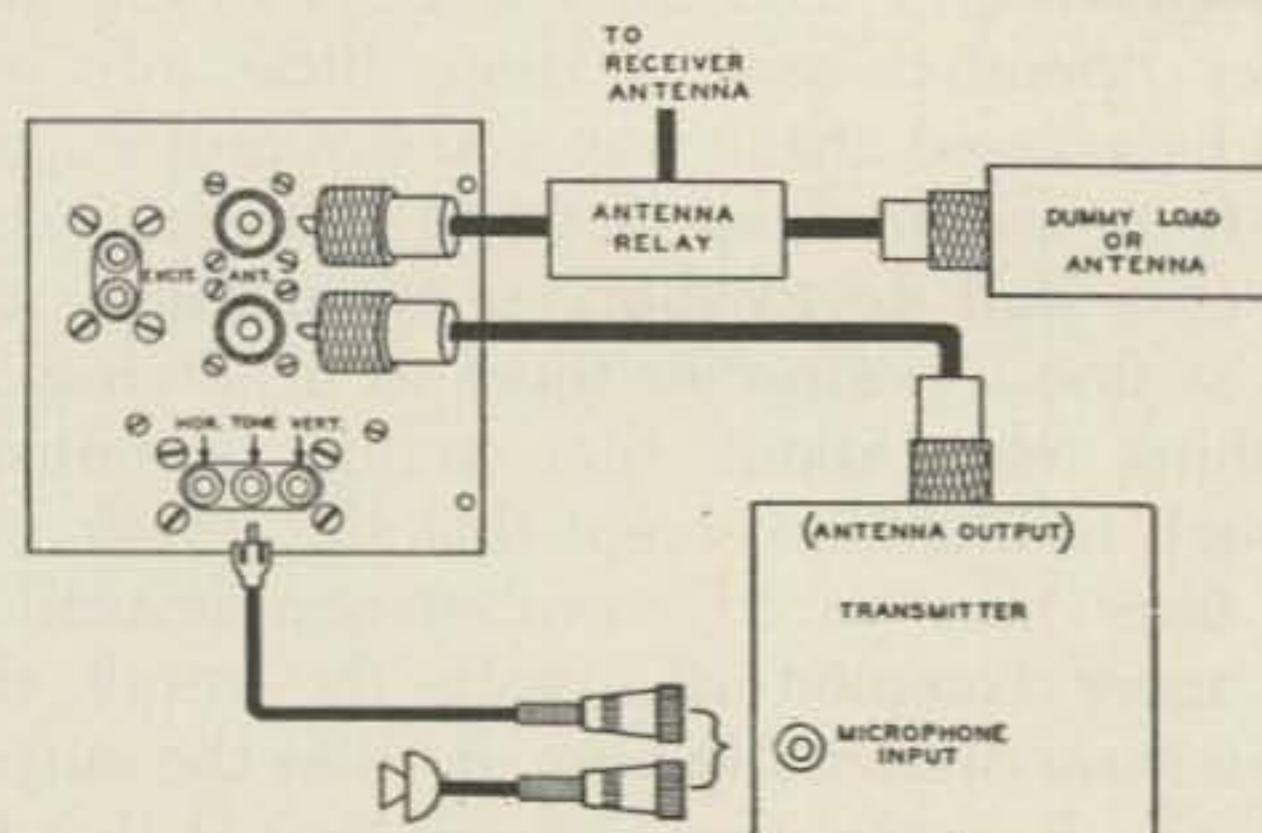


Figure 2

This drawing shows the proper connections for obtaining transmit envelope patterns. Typical patterns for various transmitter conditions are shown in patterns 1 through 21.

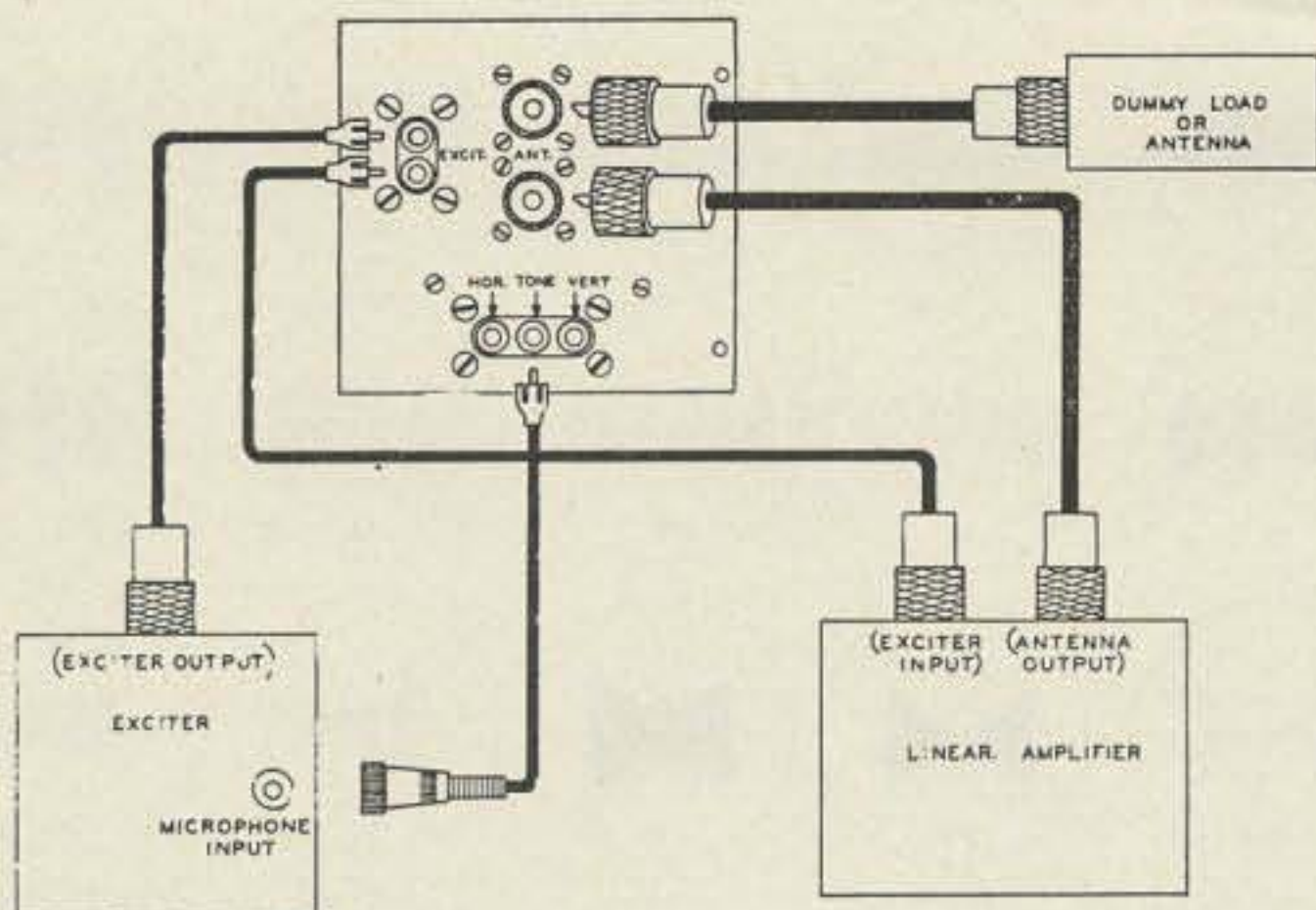


Figure 3

This connection is used to obtain RF trapezoid patterns. In this test the input of a linear amplifier is compared with the output signal. Any departure from linear operation shows up in the patterns obtained. Examples of various amplifier conditions are shown in the TRAPEZOID AND BOW TIE PATTERNS section. It should be noted that this connection indicates the operating conditions of the amplifier only.

ation of the station. Optional displays include rf envelope, rf trapezoid and the more or less conventional trapezoid and bow tie patterns. Single frequency or 2-tone audio output is available for connection to the transmitter speech amplifier *during dummy load tests*. Switching between the transmitter and receiver displays is automatic. The transmitter is fed to one vertical deflection plate of the CRT and the receiver *if* to the other; normal transmit-receive switching disables one of the two inputs.

In use, the transmitter output coaxial line is routed through the HO-10 by means of two SO-239 connectors. A portion of the rf is coupled to the vertical deflection circuit of the CRT through a step attenuator which permits use with transmitter powers ranging from five watts to well above the legal limit. The input circuit is untuned and substantially independent of frequency to over 100 mc and is usable at higher frequencies.

In addition to use as a transmitter and receiver monitor, the HO-10, within the limitations of sweep frequency, makes a perfectly acceptable utility oscilloscope. While the instrument has many circuit features that would be of interest to the technically inclined reader, the specifications will have to tell the story. We are providing a special bonus feature in this article and space does not permit a lengthy discussion of circuit details or presentation of the HO-10 schematic diagram. Sufficient to say that the circuitry is more than adequate to meet all claims in the specifications.

Parts used in the HO-10 Monitor Scope were found to be of high quality. The mechanical

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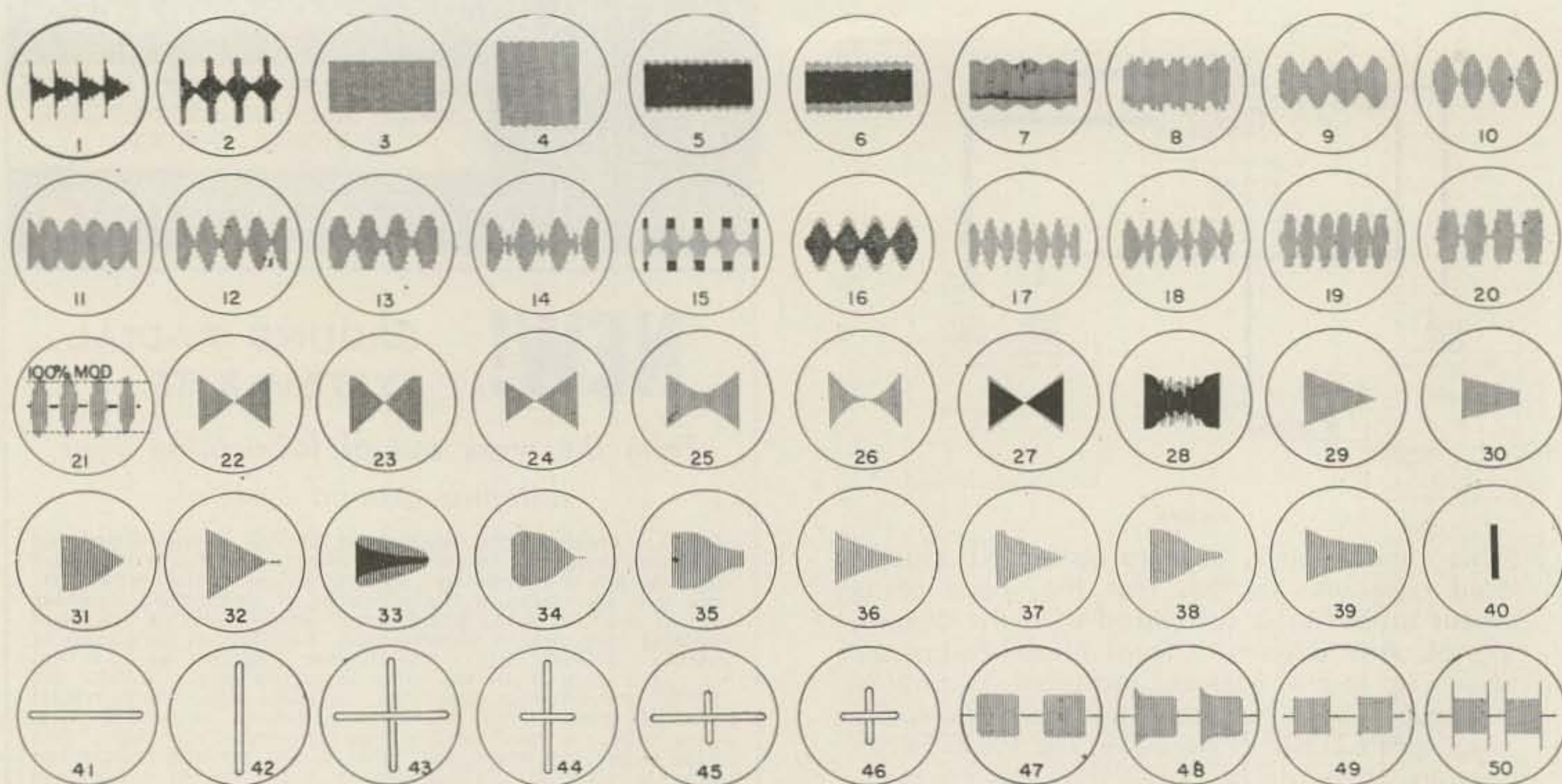
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1) SSB signal, voice input, correctly adjusted. 2) SSB signal, voice input, slightly excessive speech gain, or insufficient amplifier loading. 3) Pure CW carrier or perfect single tone input on SSB. May also occur on single tone SSB with excessive drive which results in amplifier "flat topping." Note absence of fine ripple. 4) SSB signal, single tone input, sideband suppression down approximately 40 db or CW signal with spurious radiation down approximately 40 db. 5) Same as 4 except down approximately 20 db. In SSB, the poor suppression may be due to audio unbalance or improper RF phase shift. 6) Same as 4 down approximately 10 db. 7) SSB signal, single tone input with carrier leakage. This pattern will have half the number of ripples due to poor sideband suppression. (See waveform 5.) 8) SSB signal, single tone input. Distortion in audio oscillator or audio system, balanced modulator detuned, or insufficient RF in balanced modulator. 9) SSB signal, single tone input. Very little sideband suppression. Caused by defective modulator tube; audio phase shift network; 90 degrees RF phase shift component; partially shorted modulation transformer; secondary of transformer that feeds audio phase shift network shorted to ground; crystal oscillating on two adjacent frequencies simultaneously or both heterodyne oscillators on together. 10) Normal double sideband, single tone input. SSB signal, single tone input with no sideband suppression. May be due to one modulator tube dead, modulation transformer open or shorted, defective bandpass filter. Normal SSB signal, two tone input, tones properly adjusted for equal amplitude. 11) SSB with carrier, single tone input. Incorrect value of carrier or modulation. Excessively rounded tops would indicate too much carrier. 12) Plate modulated AM, or double sideband with carrier inserted, single tone input. Nearly 100% modulated. Excellent waveform. 13) Double sideband with carrier inserted (low level AM), single tone input. Too much carrier inserted. Note that the positive peaks flatten before a fine base line is obtained. Peak flattening may also be caused by insufficient antenna loading, insufficient inter-stage loading, an overdriven linear amplifier, poor dynamic power supply regulation, etc. 14) Double

sideband with carrier inserted (low level AM), single tone input. Insufficient carrier insertion or excessive audio, resulting in high distortion (overmodulated). Also called Double Sideband Reduced Carrier (DSRC). 15 & 16) Low or high level AM with strong parasitics appearing on modulation peaks. Very fine, "Grassy" appearance on peaks would indicate parasitic in the UHF range. 17) SSB, two tone input, or double sideband, single tone input; carrier leakage in either causes uneven height of successive half cycles of modulation envelope. 18) Low or high level AM, single tone input. Severe distortion in modulator system or AF tone generator, RF feedback to audio system, or RF feedback to previous low level stage. 19) Non-linearity in modulated RF stage, single tone input, due to insufficient excitation of a plate modulated stage, overdrive to a grid modulated stage, or insufficient antenna loading of a grid modulated stage. 20) Plate modulated AM, single tone input. Overdriven modulator incapable of 100% modulation. May also result from deliberately "clipped" audio not properly filtered. 21) Plate modulated AM, single tone input. Modulator output more than ample. Modulation in excess of 100% in both directions. 22) Good linearity. Desired pattern. 23) Peaks slightly flattened. Caused by overdrive (grid current curvature), insufficient antenna loading, or regeneration. 24) Carrier leakage through working modulator. 25) Carrier leakage through disabled modulator. 26) Grid bias curvature. Caused by excessive bias, or by operating some types of tubes with high plate voltage and high bias. May also be due to regeneration, or imperfect neutralization. 27) Spurious radiation about 20 db down or insufficient selectivity in RF circuits, allowing undesirable beat products to pass through. 28) Parasitic oscillation. 29) Plate modulation, single or double sideband with carrier, or RF trapezoid. Good linearity. Desirable pattern. 30) Plate, grid or cathode modulation; double sideband or SSB with carrier. Modulation less than 100%. No distortion. 31) Nonlinear. With plate modulation, indicates lack of grid drive or insufficient grid bias. With grid modulation, SSB or DSB with carrier, or RF trapezoid through linear amplifier, indicates overdrive, insufficient antenna loading, grid cur-

rent curvature or regeneration. 32) Plate modulation in excess of 100% in downward direction. Both modulator and final show good modulation capability. 33) Plate modulation. Audio phase shift due to improper audio connection. Modulated approximately 80%. 34) Plate modulation. Overmodulation in downward direction, with insufficient modulator capability. 35) Plate modulation. Inadequate or mismatched modulator. 36) Non-linear. With plate modulation this indicates regeneration due to improper neutralization. In linear operation this also indicates regeneration, or excessive grid bias. 37) Parasitics occurring on modulation peaks. 38) Screen grid or suppressor grid modulation, maximum modulation capability. 39) Grid modulation with improper neutralization and reactive load. 40) Unmodulated carrier. Can be caused by: No signal at horizontal deflection plates. Tone test oscillator inoperative. Gain control turned off on transmitter or oscilloscope. Audio failure in transmitter. 41) Mark only. The relative narrowness of the ellipse provides good indication of the channel separation capability in the terminal unit. 42) Space only. The relative narrowness of the ellipse provides good indication of the channel separation capability in the terminal unit. 43) RTTY signal, proper shift, correctly tuned in. 44) Incorrect shift, space tuned in. 45) Incorrect shift, mark tuned in. 46) "Straddle" tuning of incorrect shift. 47) Good CW pattern, properly shaped keying, string of dots. Pattern can be approximately "locked" using automatic keyer or bug. 48) CW pattern showing effect of receiver AVC action or poor power supply regulation in the transmitter. 49) CW pattern, mild key clicks. 50) CW pattern, severe key clicks.

assembly of the kit consists of a wrap-around frame with a chassis plate mounted vertically in the frame. This assembly is then secured to the formed aluminum panel. The chassis material is fairly light gauge aluminum with a gold anodized finish. Despite the lightness of the material used, a very sturdy assembly results when it is all screwed together. As shown in the photograph, the substantial CRT bezel, attractive (and functional) CRT grid scale and the two-tone finish all combine to make a very attractive package.

The instruction manual is very comprehensive, consisting of 60 pages, 8½"x11", with 19 major assembly drawings and countless other drawings showing components, assembly details, equipment interconnection and typical scope patterns. The detailed, step-by-step assembly instructions were followed to the letter. No errors of any kind were found in the manual and no problems encountered in the construction. After construction, the scope was tested, following the instructions, and everything checked out perfectly. Assembly time, from start through final test, was just under 12 hours.

The design concepts and performance objectives for the HO-10 Monitor Scope were quite

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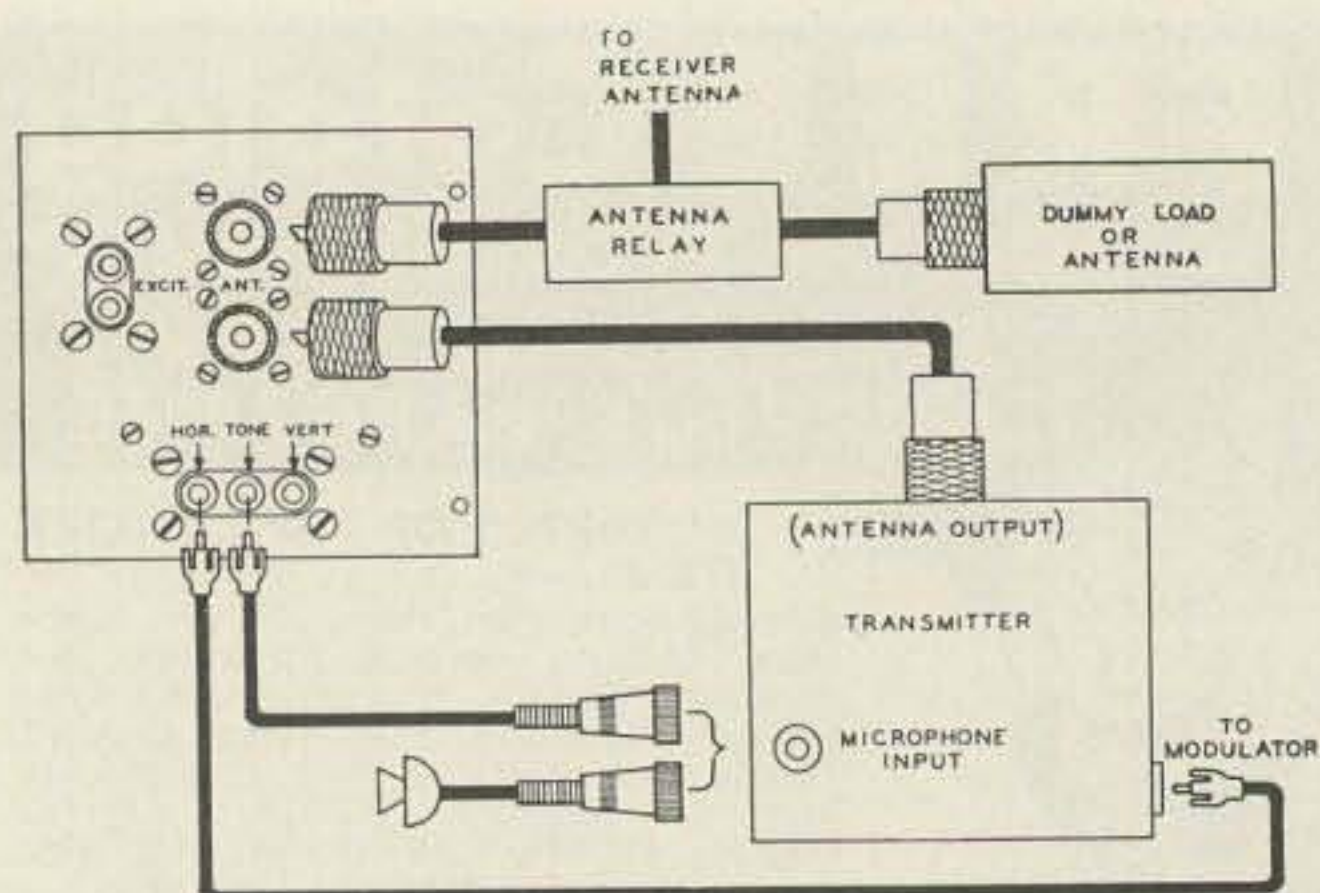


Figure 4

Test connections for obtaining the classic trapezoid and bow tie patterns. Typical patterns for various transmitter conditions are shown in patterns 22 through 40.

ambitious for a moderately priced kit. Heath is to be commended for the manner in which the production instrument achieves these objectives. Three amateurs have participated in this test and we all have nothing but praise for the scope. Heath is also to be commended on the instruction manual which should enable even the inexperienced amateur to construct the scope and, more important, use it to the best advantage of all who use our bands.

A full 19 pages of the manual are devoted to operation, interconnection of the instrument with station equipment and typical scope patterns. This is the most comprehensive collection of diagnosed scope pattern drawings the writers have found in any single reference. These drawings are of such obvious value and general interest that our immediate reaction was to call the Editor to see if he would agree to devoting the space for their reproduction as a part of a review article. Wayne's reaction was enthusiastic. The next step was to obtain Heath's permission for reproduction and here they are. Figures 2 through 5 show typical installations of the monitor scope. The captions indicate the type of displays that will be obtained. The actual waveforms depict operating conditions ranging from wonderful to horrible and, where appropriate, suggested corrective action is indicated. . . .W4WKM

SPECIFICATIONS

- VERTICAL AMPLIFIER**—Frequency Response: ± 3 db from 10 cps to 500 kc. Sensitivity: 500 mv per inch deflection. Input Resistance: 50 K Ω .
- HORIZONTAL AMPLIFIER**—Frequency Response: ± 3 db from 3 cps to 30 kc. Sensitivity: 800 mv per inch deflection. Input Resistance: 1 megohm.
- SWEEP GENERATOR**—Recurrent Type: Linear sawtooth produced by internal sweep generator. Frequency: 15 to 200 cps (variable).
- TOE OSCILLATORS**—Frequencies: Approximately 1000 cps and 1700 cps. Output Voltage: 15 mv (nominal).

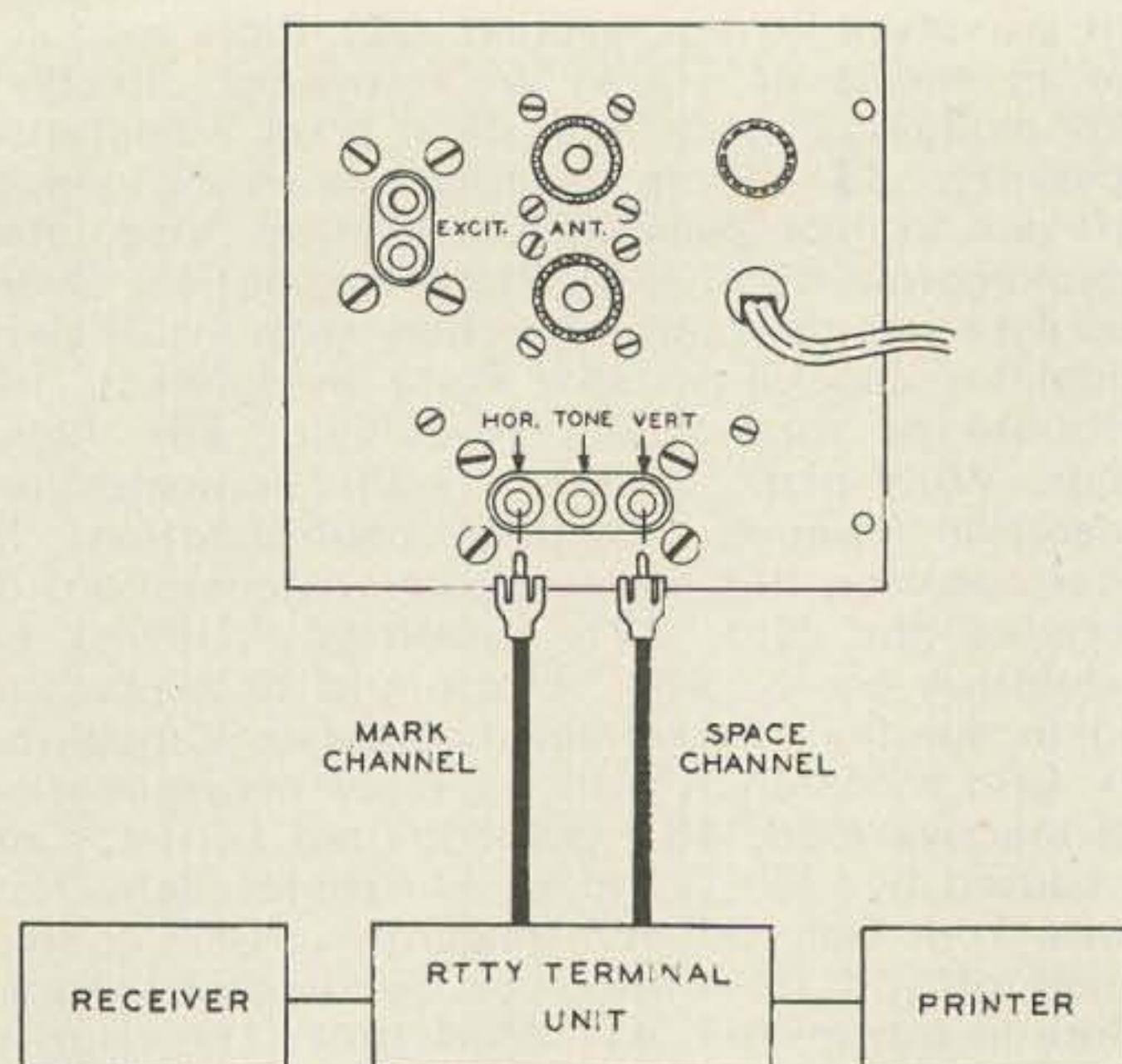


Figure 5

Test connections for obtaining RTTY cross patterns. This connection is useful in evaluating both converter performance and received signal characteristics. Typical displays are shown in patterns 41 through 46.

GENERAL—Frequency Coverage: 160 through 6 meters (50-75 Ω coaxial input). Power Limits (At rear coaxial connector): 5 watts to 1 kilowatt output. Tube And Diode Complement: 1—3RP1 CRT, medium persistence, green trace. 1—6BN8 Clamper, low level RF detector. 1—6C10 Sweep generator, horizontal amplifier. 1—6J11 Twin phase shift tone generator. 1—12AU7 Vertical amplifier. 1—1V2 High voltage rectifier. 4—Silicon diodes, B+ rectifiers. Front Panel Controls: FUNCTION Selector. SWEEP FREQ. TONE GEN. HOR. GAIN. HOR. POS. VERT. POS. VERT. GAIN. FOCUS. INTENSITY/OFF. Rear Control: XMTR ATTEN. Attenuates 0 to 24 db at approximately 6 db per step. Power Supply: Transformer operated, fused at $\frac{1}{2}$ ampere. Power Requirements: 105-125 VAC, 50/60 cps, 35 watts. Dimensions: 5 $\frac{1}{4}$ " high 7 $\frac{3}{8}$ " wide x 11" deep (including knobs). Net Weight: 8 $\frac{1}{4}$ lbs. Shipping Weight: 10 lbs.

(W2NSD from page 75)

To sum it up. I cannot see that the ARRL has proved that there are any advantages to their proposed incentive licensing plan, nor have I yet seen any indication that they are speaking for their members in this move.

Club News Bulletin

Now that we have bulletin printing facilities at the 73 Hq we can renew the publication of the Club News Bulletin which was so popular.

This bulletin comes out monthly and is designed to be of help to the editors of club bulletins and to provide news of interest to club officers. The editor, Marvin Lipton VE3-DQX, scans all of the club bulletins each month and excerpts the news of interest for other editors to use. He also passes along lots of information of great value to club officers