INSTRUCTION MANUAL

THE

TRANSALYZER MARK IIIA

TRANSEL CORPORATION

INDIANAPOLIS, INDIANA

The TRANSALYZER MARK IIIA

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The Transalyzer is a precision in-line instrument designed for usage with 50 ohm coaxial radio frequency systems. It continuously monitors the output of a transmitter. In adddition, the Transalyzer can be connected to a receiver for the purpose of analyzing received stations. The Counter Model Mark IIIA-C can be utilized to measure the transmitted frequency , or the frequency of other equipment.

Transmitter monitoring includes the 160 through 10 meter Amateur bands, and the 11 meter CB band. Both Amplitude Modulated (AM) and Single Sideband Suppressed Carrier (SSB) signals can be analyzed.

Received monitoring of AM and SSB signals can be performed for stations well above 30 MHz; the maximum frequency depends upon the receiver.

There are two (or three) types of displays: a Wattmeter, an Oscilloscope, and a Frequency Counter in the Mark IIIA-C. The Wattmeter (transmitt only) indicates output power, either peak or average, up to a maximum of 2000 watts. In addition, the standing wave ratio (SWR) and associated percent reflected power can be measured. Percent reflected power is the percentage of forward (transmitted) power that is being reflected back from the antenna.

The oscilloscope displays the percentage of modulation, modulation distortion, hum or ripple in an AM or SSB signal on transmitt in conjunction with the two-tone oscillator. In receive monitoring, the same things can be determined but with more difficulty unless the transmitting station employs a tone oscillator.

A minimum of 2 and 1/2 watts (on Transmit) is required for proper Transalyzer operation. A phone jack allows the modulation in an AM transmitted signal to be heard through earphones. (System will not function with SSB).

ADDITIONAL INFORMATION

Nearly all transmitters will modulate 100% negative (centerline) very easily, but many will not modulate more than 70 to 80% in the positive direction. An AM transmitter should not be modulated beyone the point where negative modulation goes to 100%, or the positive peaks are flattened. A SSB transmitter, with two-tone oscillator input should not be modulated beyone the point where positive peaks start to flatten. Any transmitter will sound the loudest and clearest when operated in this manner.

OPERATING INSTRUCTIONS

1. Transmitter Monitoring

   A. connect the Transalyzer to an antenna, radio and the AC line.

   B. Turn the unit on; the red panel light should come on immediately. A trace should appear on the screen within one minute. If not, turn the intensity control clockwise.

   C. Adjust the focus control for the sharpest trace.

   D. Adjust the vertical position control until the trace is on the line beside the R.F. Carrier.

   E. Place the watt/SWR control in a power range that is greater than expected power from the transmitter.

   F. Place the SWR cal, and tone controls at minimum.

   G. Place the tone switch in off, and the watts switch in peak.

2. AM OPERATION

   A. Energize the transmitter and adjust the vertical size control until the pattern touches the line at arrow tips as shown in Fig. 1.

   B. Whistle into the microphone, ideally the pattern should be as shown in Fig. 2. Fig. 4 is poor. Ideally, the power reading should quadruple under 100% modulation.

   C. If desired, the wattmeter can be placed in average position. The wattage should remain about the same during modulation. If the modulation is similar to Fig. 4, the reading will drop to a small percent of the unmodulated value.

   D. SWR is measured with unmodulated carrier by setting the watt/SWR control to cal, and adjusting the SWR cal control until the meter pointer is at SWR cal. Turn the wall SWR control to read; the SWR and percent reflected power are indicated directly.

   E. If desired, a tone adapter, described in installation can be utilized. Connect the adapter between the tone output and the transmitter microphone connector. Adjust the tone control until negative peaks are at zero (Fig. 2) and read % positive modulation with tone switch at 1.

3. SINGLE SIDEBAND OPERATION

   A. Connect tone output to transmitter with tone adapter (described in installation) and place tone switch in position 1 & 2.

   B. Increase tone control, and adjust vertical size until pattern fills most of the screen. Continue to increase until positive peaks are slightly flattened.

C. Change tone switch to 1 and readjust vertical size until pattern is between arrow points as in Fig. 1.

D. Multiply the power reading by four to obtain the P.E.P. (Peak Envelope Power).

E. Switch back to tone 1 & 2; read % of positive modulation.

F. The power reading (P.E.P.) is read directly. This method is more accurate than the previous one. The watts switch must be in peak position.

G. SWR can be measured by placing watt/SWR control in cal. Place tone switch in 1 and energize transmitter. Adjust SWR cal control until pointer is at SWR cal line. Then place Watt/SWR control in read. SWR and percent reflected power are directly indicated.

4. RECEIVING CAPABILITY

A. The oscilloscope can be used to analyze received signals.

B. Connect a cable from the receiver to the receive monitor connector as described in Installation.

C. Tune the receiver until the station sounds the best. Adjust the vertical size control during quiet moments until the carrier produces a pattern between lines as shown in Fig. 1. The percentage of modulation is read from the screen.

D. For SSB signals, adjust the vertical size control until the pattern is between the 100% lines.

E. If transmitting station utilizes a two-tone oscillator for SSB, set pattern between tips of arrows for 1 tone operation, and read modulation during 2 tone operation.

5. COUNTER OPERATION

A. Turn counter on and place dim/bright switch in desired position.

B. The carrier frequency of an AM transmitter can be displayed to an accuracy of + or - 100 Hz. The counter will not function properly during modulation and will not measure received frequencies.

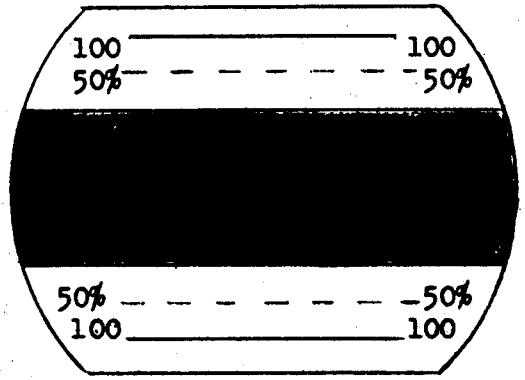
C. There are two methods of measuring a SSB transmitter frequency. If practical the transmitter should be tunes to produce a carrier. Alternately, tone 1 from the two-tone osc. is coupled into the transmitter. With upper sideband operation, subtract 1800 Hz from the counter frequency; for lower sideband operation, add 1800 Hz to counter display. The counter will not function properly with normal voice operation and will not measure received frequencies.

D. The frequency, 1 KHz to 50 MHz, of a local device can be measured by connecting it to the counter connector on the back panel.

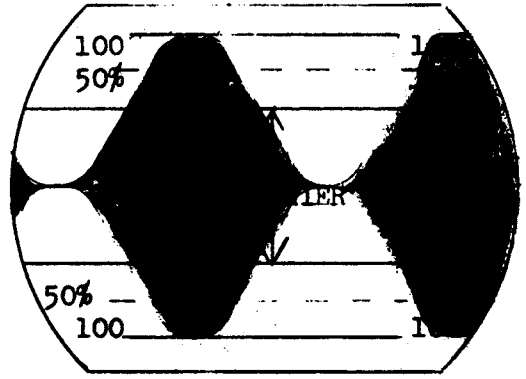
6. HEADPHONE OPERATION

Plug high impedance (2000 ohm) magnetic headphones into phone jack. Modulation from an AM transmitter can be heard and the volume adjusted. A crystal or ceramic headphone often supplied with transistor radios can be used if it

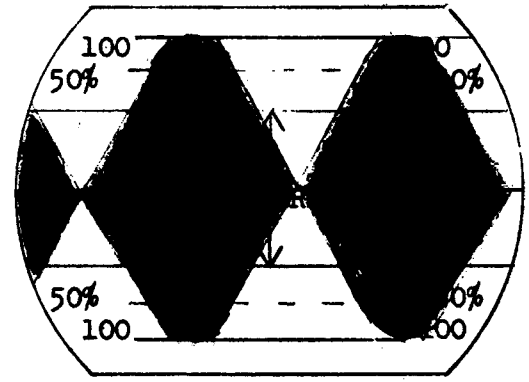
OSCILLOSCOPE DISPLAYS



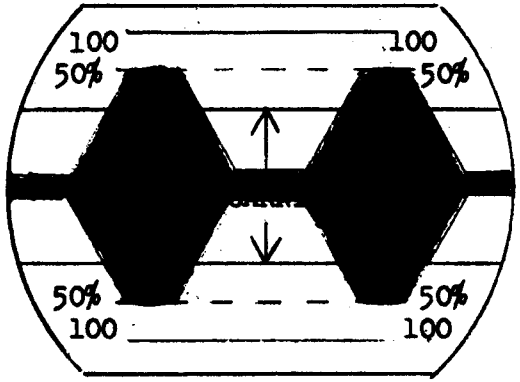
AM Carrier or
SSB (1 tone)
Fig. 1



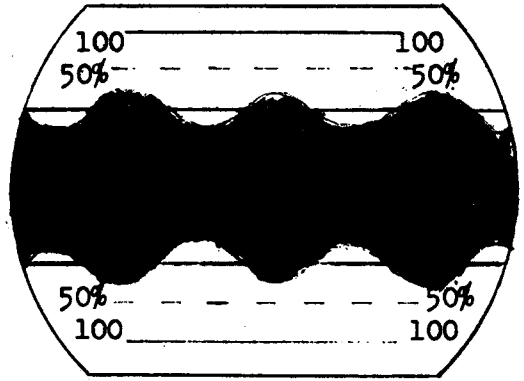
Ideal AM Pattern
(1 Tone)
Fig. 2



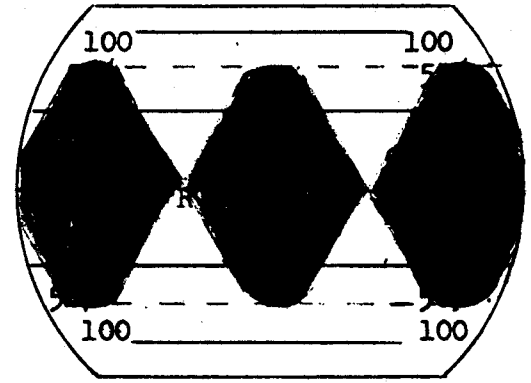
Ideal SSB Pattern
(2 Tones)
Fig. 3



Poor AM Pattern (1 Tone)
Note gaps in pattern
Fig. 4



AM Pattern 25% modulation
by 1 Tone, or SSB Pattern
with incomplete sideband
suppression (1 Tone)
Fig. 5



SSB Pattern
2 Tones
Poor Modulation
Fig. 6

is replaeed by a high impedance type. The small plug is replaced by a 1/4 inch 2 conductor type. Headphones of the 8 ohm high fidelity type will not function with the Transalyzer.

INSTALLATION

1. Transmitter Connection

Coaxial cable to the antenna and radio connectors must be 50 ohm type; RG-58 is recommended except for power levels in excess of 300 watts where RG-8 should be used. The cable connectors should be "press together" types such as Amphenol 83-58, or PL-259 with UG-175/U adapter for RG-58; and PL-259 without adapter for RG-8 Cable.

2. Receive Connection

A. The Transalyzer can be connected to display incoming signals from a receiver. This connection should be performed by an Electronics Technician. Shielded or coaxial cable to the receive monitor connector can be of any impedance, but it is important to reduce cable length to a minimum.

B. Connect the center conductor through a small capacitor (5pf. to 15 pf.) to the plate or collector of the last I. F. amplifier before the detector. The shield, of course, should be grounded to the radio. A BNC plug (UG-88/U) is connected to the other cable end.

3. Two Tone Oscillator Adapter

A. This adapter couples audio signals from the Transalyzer tone jack to the microphone input on the transmitter. In addition, if the microphone is a "push to talk" type, provision must be made to energize the transmitter.

B. An adapter is not included because it would be different for various types of transmitters.

C. It is advisable to have an Electronics Technician construct the adapter.

D. If the transmitter does not utilize a "push to talk" microphone, connect a phone plug to a microphone connector (identical to the one of microphone cable) by a single conductor, plus shield, cable.

E. If "push to talk" microphone is used; a small box with a SPST mounted switch will also be required. The switch, naturally, replaces the "push to talk" function of the microphone. A 2 conductor plus shield cable will be required from the box to microphone connector. (3 wire plus shield cable if the keying circuit is ungrounded).

4. Counter Input (on Mark IIIA-C only)

RG-58 cable should be coupled to a BNC Plug (UG-88/U) for counter input usage. This plug fastens to the counter input connector.

5. Electronic Equipment Placement

In some cases, electronic equipment placed on top of, or to one side of the Transalyzer may cause movement or distortion in the cathode ray tube pattern. The solution is to move the equipment a few inches away from, or to one side of the Transalyzer.

THEORY OF OPERATION (see block diagram)

Wattmeter:

A sample Radio Frequency Signal is coupled from the 50 ohm coaxial line into a bridge circuit that is balanced for reflected power, but unbalanced for forward power.

The bridge output is detected and coupled into a panel meter. In the SWR mode, the bridge is unbalanced for reflected power and balanced for forward power. This allows the SWR and corresponding percent reflected power to be easily measured.

Earphones:

A sample RF signal is coupled from the 50 ohm coaxial line and detected. The resu-tant audio signal is coupled to the earphone jack. This system allows the modulation of an Amplitude Modulated transmitter to be heard. (System will not function properly with SSB).

Oscilloscope:

For normal oscilloscope operation, a sample RF signal is coupled from the bridge to a double balanced mixer. An oscillator, which operates at one of two frequencies, also drives the mixer. The difference is frequency passes through the low pass filter. The mixer is bypassed for 160 and 80 meter operation, and the RF signal is coupled directly into the low pass filter. The filter output is coupled into an adder and then to the push-pull vertical amplifier, which connects to the vertical deflection plates.

A sample signal from the vertical amplifier is detected, amplified, and leveled to produce constant amplitude pulses. These pulses synchronize the ramp generator so that the modulation pattern is stationary.

The ramp generator (horizontal oscillator) consists of a constant current source which charges a capacitor, which is discharged when the capacitor voltage reaches a fixed level. This initiates the discharge of a second capacitor; the next ramp is delayed (hold-off time) until the second capacitor voltage drops to a fixed level (free-running) unless a synchronizing pulse initiates the ramp (triggered sweep). The second capacitor is recharged during the ramp time.

Horizontal oscillator signals are coupled to the push-pull horizontal amplifier and then to the horizontal deflection plates.

During the trace (ramp), a signal from the horizontal oscillator cuts off the unblanking amplifier. This biases the CRT into conduction. (CRT normally biased to cutoff). As a result, the CRT has no retrace effect.

For receive monitoring, an IF signal is coupled to an adder, is amplified, coupled through a high pass filter to another adder, and then drives the vertical amplifier in the normal manner.

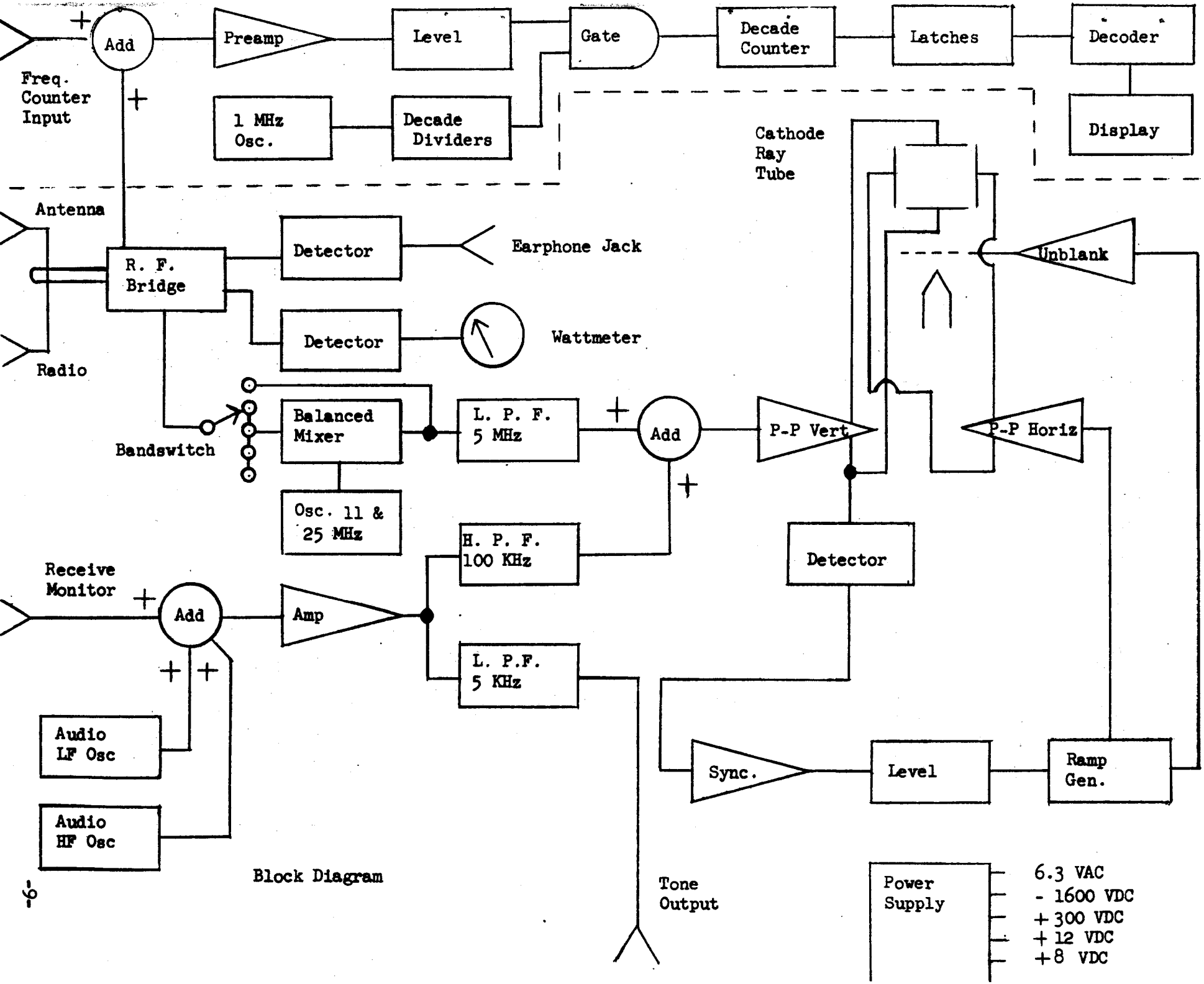
There are two audio oscillators; one for low and one for high frequency generation. The outputs are combined in an adder and then amplifier. The signals are coupled through a low-pass filter to the front panel jack.

COUNTER MODEL

The counter measures the transmitting frequency, or the frequency of a local source, but will not measure received frequencies.

The transmitting signal sample is coupled from the RF bridge to an adder and then through an amplifier to a leveller circuit, which has an output of constant amplitude pulses. These pulses are applied to the gate,; A 5.24288 MHz frequency, from an oscillator, is divided, and used to operate the gate for short periods. Pulses from the gate operate the decode counters and the latches hold the count. The decoder converts the count into signals that drive the 7 segment displays. The display is updated every 100 milliseconds (about 10 times each second).

The counter will also display the frequency of a signal applied at the counter input connector; it is coupled to an adder and then to the Preamplifier.


Add
Preamp
Level
Gate
Decade Counter
Latches
Decoder
Freq. Counter Input
1 MHz Osc.
Decade Dividers
Display
Cathode Ray Tube
Antenna
R. F. Bridge
Detector
Earphone Jack
Unblank
Detector
Wattmeter
Radio
Balanced Mixer
L. P. F. 5 MHz
Add
P-P Vert
P-P Horiz
Bandswitch
Osc. 11 & 25 MHz
H. P. F. 100 KHz
Detector
Receive Monitor
Add
Amp
L. P.F. 5 KHz
Audio LF Osc
Audio HF Osc
Sync.
Level
Ramp Gen.
Block Diagram
Tone Output
Power Supply
6.3 VAC
- 1600 VDC
+ 300 VDC
+ 12 VDC
+ 8 VDC

CALIBRATION

The Transalyzer is calibrated at the factory. It should not be necessary to recalibrate any circuit for a number of years unless some part changes in value.

WATTMETER

1. Bridge Balance

   A. Turn off AC line switch.

   B. Connect a 50 ohm dummy load to antenna terminal and the transmitter to radio connector on Transalyzer. Transmitter power minimum 3 watts and frequency preferably 21 MHz, or most often used frequency. Dummy load should have a rating 10 times transmitter power.

   C. Remove cover from small aluminum box.

   D. Set watts control to read, and SWR control to minimum.

   E. Energize transmitter (carrier only) and adjust SWR control for an appreciable meter reading.

   F. Adjust the balance control (variable capacitor) on Board 540-0018 with a non-metallic tuning tool. Adjust for minimum meter reading. If reading nears zero, increase by means of SWR control and readjust for minimum.

2. SWR Compensation Control

   A. Connect a transmitter (minimum 3 watts) and a 100 ohm calibrated mismatch to Transalyzer. Cable length to 100 ohm mismatch should be as short as practical.

   B. Switch wattage control to read, and adjust SWR cal until pointer is at 2 on SWR scale.

   C. Switch to cal and adjust SWR compensation control (on left side of wattmeter board as viewed from back) until SWR is at Cal Set position.

   D. Repeat steps B & C until readings stabalize.

3. Calibrating Ranges

   A. Connect a transmitter, Transalyzer, a 50 ohm reference wattmeter, and a 500 watt 50 ohm dummy load in series.

   B. Calibrate at about 5, 50, and 500 watt points for best accuracy.

   C. Calibration controls for the 20, 200, and 2000 watt ranges are center to right side of wattmeter board as viewed from the back.

4. Peak-Average Switch

When a 100% modulated signal is applied to the Mark IIIA, the power reading should nearly quadruple when the switch is in peak position as compared with an unmodulated carrier.

5. Two-Tone Oscillator Calibration (Board 540-0015)

A. Set R2 (tone balance) to mid-position.

B. Place tone switch in 1 & 2 position. Place oscilloscope probe on upper left terminal of tone balance control. Adjust R11 (tone 1 Adj.) for maximum amplitude with no observable distortion in the sine wave.

C. Move probe to right upper terminal of tone balance and adjust R14 (tone 2 Adj.) for maximum amplitude with no observable distortion in sine wave.

D. Place probe on tone output jack and adjust tone level control for maximum. Set tone balance so that P-P amplitude exactly doubles when tone switch is changed from 1 to 1 &2.

6. Vertical Amplifier (board 540-0014)

A. Adjust L 1 (red coil) for maximum inductance (core inside all turns).

B. To set oscillator frequency; turn bandswitch to 10 meters. Place single turn pick-up loop connected to a counter near coil L 6 (black coil). Adjust L 6 with a non-metallic tuning tool for a frequency of 25.5 MHz.

C. Change bandswitch to 40 M; frequency should be about 10.5 MHz. If necessary, readjust coil L 6 to split the difference so that both frequencies are near the desired values.

D. DC Level Adjustment (R 14)

1. Set transmitter to frequency most often used and set Transalyzer Bandswitch accordingly.

2. Energize transmitter and adjust vertical size control until pattern is between arrow points.

3. Adjust DC level (R14) for maximum pattern height.

7. Rate Board (540-0017

A. Horizontal Size (R34) and Horizontal Position (R39)

Adjust front panel intensity and vertical position controls until trace is on lines beside RF Carrier. Adjust R34 (size) and R39 (Position) until trace is centered and overscanning each edge by about 1/8 inch.

B. Horizontal Rate (R 45)

Whistle into microphone and adjust Rate Control until there are 3 or 4 modulation envelopes on oscilloscope display.

C. Astigmatism (R21)

Adjust astigmatism control in conjunction with front panel focus control to obtain the brightest and sharpest trace obtainable.

8. Sensitivity

Input sensitivity on each band should be such that not more than 2 watts are required for deflection between the arrow points.

9. Synchronization

The pattern should synchronize (not drift across screen) when the transmitter is modulated 25% by a tone. (Vertical position adjusted for center of screen, and Vertical Size adjusted for carrier between points or arrows).

10. Receive Capability

A 0.01 Volt (RMS) signal , 400 KHz to 5 MHz, should provide deflection between arrow points when applied to the receive monitor input. (Receive Size set at maximum).

11. Counter Calibration

The correct oscillator frequency is 5.24288 MHz, but it is simple to couple a known frequency into the counter input and adjust oscillator frequency until same frequency is displayed. An oscillator synchronized with WWV is an excellent source.