INSTRUCTION MANUAL

Type 1383 Random-Noise Generator

A

GENERAL RADIO

Contents

WARRANTY

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, District Office, or authorized repair agency personnel will be repaired or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

Type 1383 Random – Noise Generator

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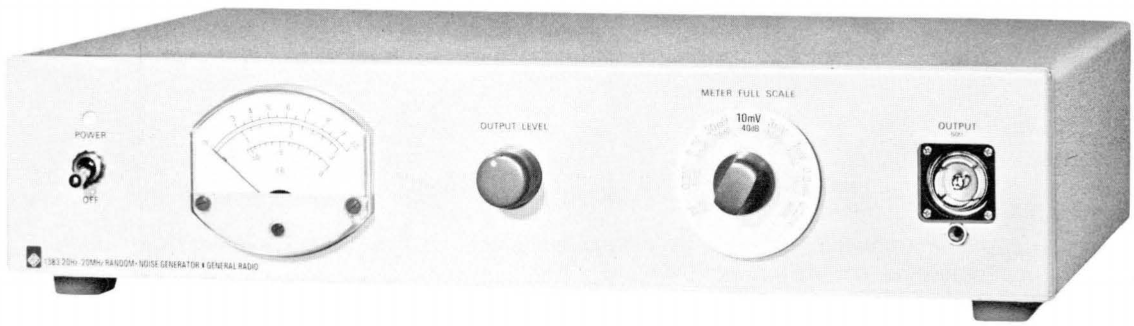
West Concord, Massachusetts, U.S.A. 01781
Form 1383-0100-A
February, 1969
ID-0100

Specifications



Spectrum: Flat (constant energy per hertz of bandwidth) ±1 dB from 20 Hz to 10 MHz, ±1.5 dB from 10 MHz to 20 MHz.

Waveform: Table shows amplitude-density-distribution specifications of generator compared with the Gaussian probability-density function, as measured in a "window" of 0.2σ, centered on the indicated values:

Voltage	Gaussian Prob. Dens. Function	Amplitude-Density Dist. of 1383 Random-Noise Gen.
0	0.0796	0.0796 ±0.005
$\pm\sigma$	0.0484	0.0484 ±0.005
$\pm 2\sigma$	0.0108	0.0108 ±0.003
$\pm 3\sigma$	0.000898	0.000898 ±0.0003

(σ is the standard deviation or rms value of the noise voltage.)

Output Voltage: At least 1 V rms max , open circuit.

Output Meter: Indicates open-circuit output voltage ahead of 50Ω.

Output Impedance: 50Ω. Can be shorted without causing distortion.

Amplitude Control: Continuous control and 8-step, 10 dB-per-step attenuator.

Output Terminals: GR874® coaxial connector that can be mounted on either front or rear panel.

Accessories Supplied: Spare fuses, lamp, power cord.

Power Required: 100 to 125 or 200 to 250 V, 50 to 400 Hz, 40 W.

Dimensions (width x height x depth): Bench: 17 x 3⅞ x 12¾ in. (435 x 99 x 325 mm); rack, 19 x 3½ x 10¾ in. (485 x 89 x 275 mm).

Weight: Net, 14 lb (6.5 kg); shipping. 21 lb (10 kg).

Catalog Number	Description
1383-9700	Bench Model
1383-9701	Rack Model

Introduction—Section 1

1.1 PURPOSE.

The Type 1383 Random-Noise Generator (Figure 1-1) provides a high level of electrical noise at its output terminals. This type of signal is useful in testing video- and radio-frequency systems for operation in the presence of noise, and for measurement of the noise figure of such systems. The noise signal can be used directly, or it can be used to modulate the output of a signal generator. It is useful in making crosstalk measurements and in determining the effective bandwidth of filters. The 20-Hz to 20-MHz bandwidth of the noise makes it useful for even wide-band video systems.

1.2 DESCRIPTION.

The 1383 Random-Noise Generator consists of a thermionic diode noise source with all-semiconductor amplifiers and power supply. The noise output is useful over the frequency range from 20 Hz to 20 MHz. The noise output amplitude is indicated by a meter on the front panel, and an output attenuator permits reduction of the output by a total of 80 dB in 10-dB steps from a maximum of 1 V, rms, open circuit. The output impedance is 50 Ω.

1.3 CONTROLS, CONNECTORS AND INDICATORS.

The controls, connectors and indicators on the front and rear panels of the 1383 Random-Noise Generator are listed and described in Tables 1-1 and 1-2, respectively.

The OUTPUT connector on the front panel is a GR874® coaxial connector. If desired, it may be removed from the front panel and mounted on the rear of the instrument. A snap-in hole cover (P/N 0480-2470) at the rear should be moved to the front if this change is made, to cover the hole in the front panel.

1.4 ACCESSORIES SUPPLIED.

The accessories supplied with the Generator are listed in Table 1-3.

1.5 ACCESSORIES AVAILABLE.

A Rack Adaptor Set (P/N 0480-9702) is available to convert the portable bench model for mounting in an EIA standard 19-inch relay rack. (Refer to paragraphs 2.3 and 2.4.)

Also available are various patch cords and adaptors, some of which are listed in Table 1-4.

GR874-G coaxial fixed attenuators can be used to reduce the output beyond the range of the attenuator in the instrument. Units are available with attenuation values of 3, 6, 10, 14, and 20 dB.

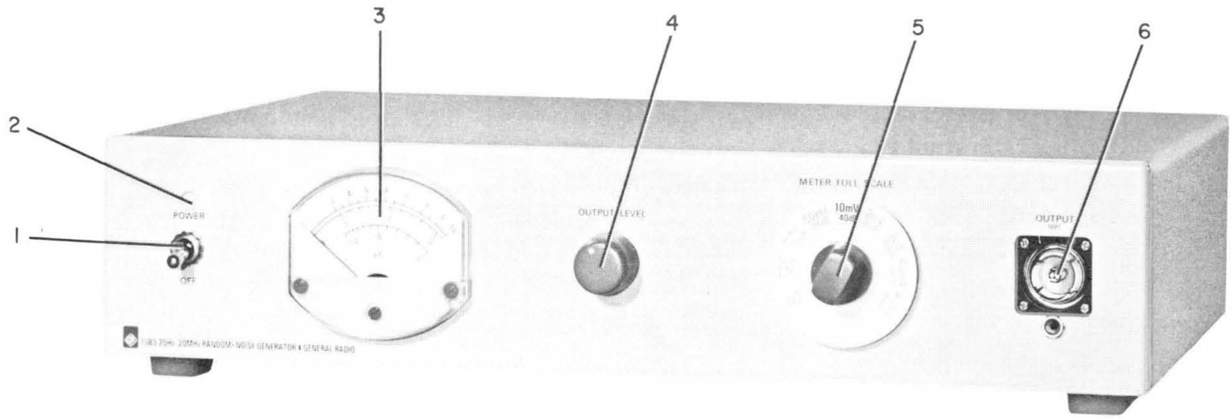


Figure 1-1. Type 1383 Random-Noise Generator.

Table 1-1

Controls, Connectors, and Indicators on the Front Panel

FIG. 1-1 REF.	NAME	TYPE	POSITIONS	FUNCTION
1	POWER	2-position toggle switch	OFF, POWER	Energizes Instrument.
2	-----------	Pilot lamp	--------------------	Indicates when instrument is energized.
3	-----------	Meter	--------------------	Indicates open-circuit output voltage.
4	OUTPUT LEVEL	Continuous rotary control	--------------------	Varies output voltage.
5	METER FULL SCALE	9-position rotary selector switch	1.0, 0.3, 0.1, 0.03, 0.01, 0.003, 0.001, 0.0003, 0.0001	Attenuates output in 10-dB steps.
6	OUTPUT 50 Ω	GR874®coaxial connector and ground jack	--------------------	Connection to generator output.

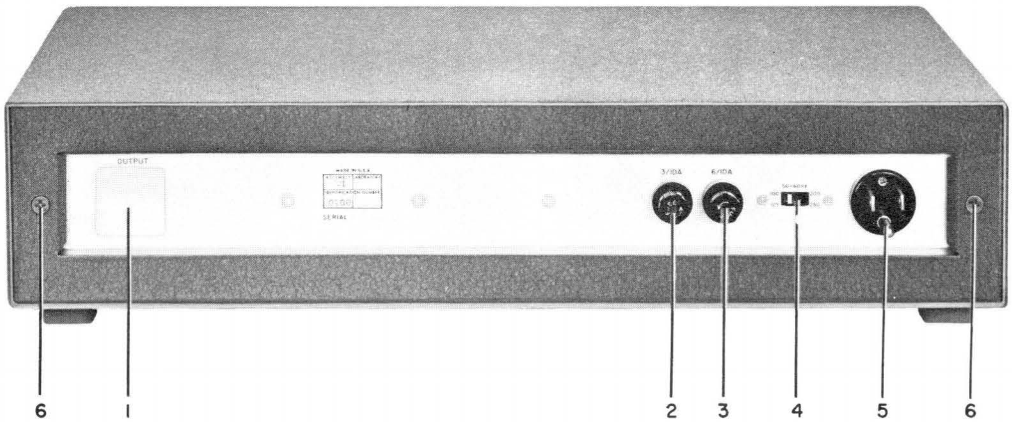


Figure 1-2. Rear panel of the Generator, showing controls and connectors.

Table 1-2

Controls and Connectors on the Rear Panel.

FIG. 1-2 REF.	NAME	TYPE	POSITIONS	FUNCTION
1	OUTPUT	(The OUTPUT connector on the front panel can be moved to this location on the rear panel.)		
2	3/10 A	Extraction-post fuse holder	-------------------	Holds 3/10 A fuse (Slo-Blo).
3	6/10 A	Extraction-post fuse holder	-------------------	Holds 6/10 A fuse (Slo-Blo).
4	------------	Screwdriver-operated slide switch	100-125, 200-250	Selects proper range of line voltage.
5	------------	3-terminal male connector	-------------------	Line-power input connection.

Table 1-3

Accessories Supplied.
(Refer also to Parts List.)

QUANTITY	ITEM	GR PART NO.
1	Power Cable, 7-foot, 3-wire	4200-9622
1	Spare Fuse (0.3 A, Slo-Blo)	5330-0800
1	Spare Fuse (0.6 A, Slo-Blo)	5330-1100
2	Spare Pilot Lamps	5600-0300

Table 1-4

Some of the many coaxial patch cords,adaptors, and other accessories available for use with the Generator (cables are approximately three feet long.)

GR PART NUMBER	DESCRIPTION	GR CATALOG NUMBER
Cables		
874-R22A	GR874 to GR874	0874-9682
874-R22LA	GR874 to GR874, locking connectors	0874-9683
1560-P95	Phone plug to double banana plug	1560-9695
776-B	GR874 to BNC (plug)	0776-9702
Adaptors, non-locking		
874-QBJA	GR874 to BNC (jack)	0874-9700
874-QBPA	GR874 to BNC (plug)	0874-9800
874-QUJ	GR874 to UHF (jack)	0874-9718
Adaptors, locking		
874-QBJL	GR874 to BNC (jack)	0874-9701
874-QBPL	GR874 to BNC (plug)	0874-9801
874-QUJL	GR874 to UHF (jack)	0874-9719
874-Q2	GR874 to binding posts	0874-9870
Fixed Attenuators, non-locking		
874-G3	3 dB	0874-9564
874-G6	6 dB	0874-9568
874-G10	10 dB	0874-9570
874-G14	14 dB	0874-9568
874-G20	20 dB	0874-9572
Fixed attenuators, locking		
874-G3L	3 dB	0874-9565
874-G6L	6 dB	0874-9569
874-G10L	10 dB	0874-9571
874-G14L	14 dB	0874-9561
874-G20L	20 dB	0874-9573
Miscellaneous, non-locking		
874-W50B	Termination, 50 Ω	0874-9954
874-T	Tee	0874-9910
874-X	Insertion Unit	0874-9990
874-TPD	Power Divider	0874-9912
Miscellaneous, locking		
874-W50BL	Termination, 50 Ω	0874-9955
874-TL	Tee	0874-9911
874-TPDL	Power Divider	0874-9913

Installation–Section 2

2.1 DIMENSIONS.

The dimensions of the 1383 are shown in Figure 2-1.

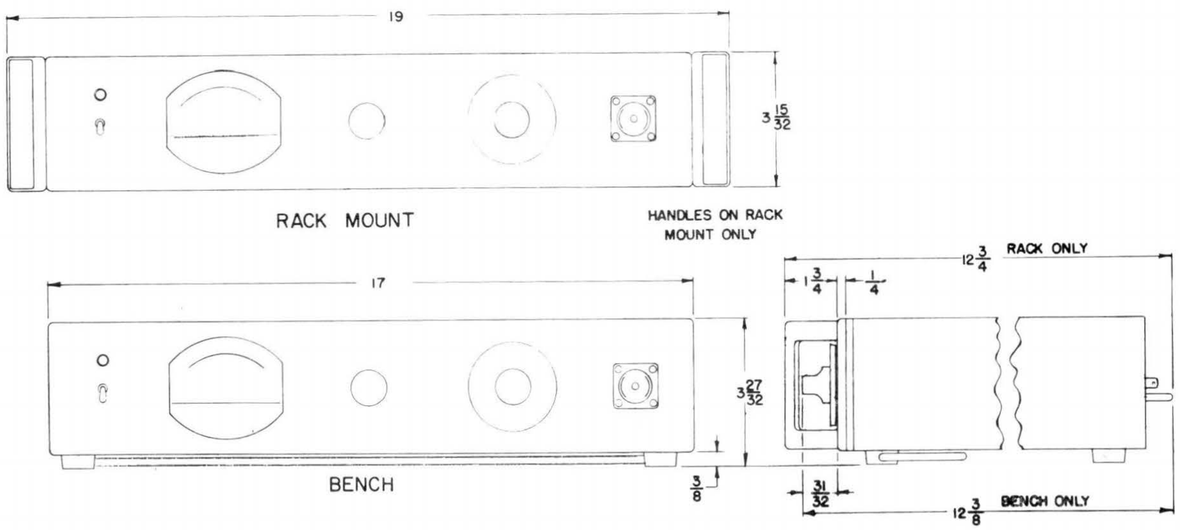


Figure 2-1. Dimensions of the Generator in inches.

2.2 BENCH MODEL.

The 1383-9700 (bench model) Random-Noise Generator is delivered completely assembled in a metal cabinet, ready for bench use. A convenient bail, located between the front feet, can be pulled down to raise the front of the instrument and provide a better view of the control settings.

To convert the bench model for relay-rack use, proceed as follows (see Figure 2-2):

a. Order an 0480-9702 Rack Adaptor Set. Table 2-1 lists the parts included in the Set.

b. Loosen the two captive 10/32 screws (5, Figure 1-2) in the rear of the cabinet until the instrument is free; slide the instrument forward, out of the cabinet.

c. Remove the four rubber feet from the cabinet. Simply push out the two rear feet. Spread the bail (A, Figure 2-2) slightly, and the two front feet (B) and the bail will drop out. Be sure to save all parts as they are removed for possible reconversion of the instrument to bench mounting.

d. Pierce and push out the plugs from the four bosses

TABLE 2-1

PARTS INCLUDED IN RACK ADAPTOR SET
P/N 0480-9702

Fig. 2-2 Ref	No. Used	Item	GR Part No.
G	2	Rack-Adaptor Assemblies (handles)	0480-4902
	1	Hardware Set includes	0480-3080
D		8 Screws, BH 10-32, 5/16" (only 4 required)	
E		4 Screws, BH 10-32, 9/16" with nylon cup washers	

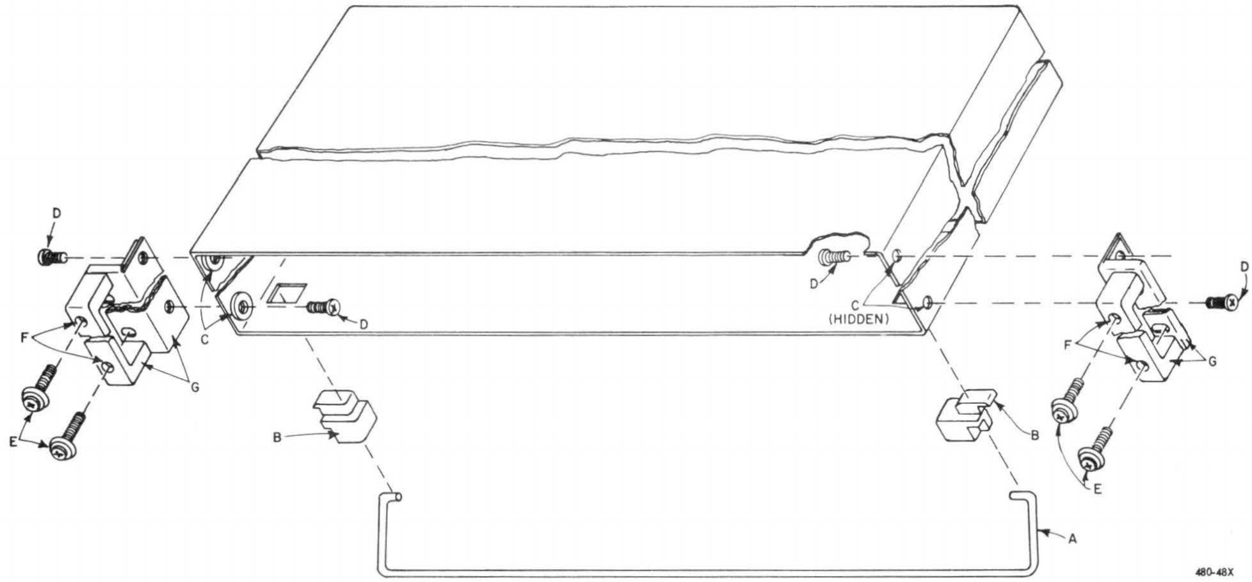


Figure 2-2. Method of mounting the Generator in a relay rack.

(C) on the inner sides of the cabinet, near the front. Do not damage the threads in the threaded holes. Push from inside the cabinet.

e. Attach one Rack Adaptor Assembly (handle) to each side of the cabinet, as shown, using two 5/16-inch screws (D) in each. Note that the screws enter in opposite directions, one from inside the cabinet and one from outside. Use the upper and lower holes in the assemblies.

f. Install the instrument in the cabinet and lock it in place with the two captive screws through the rear panel that were loosened in step b.

g. Slide the entire assembly into the relay rack and lock it in place with the four 9/16-inch screws (E) with captive nylon cup washers. Use two screws on each side and tighten them by inserting a screwdriver through the holes (F) in the handles.

To reconvert the instrument for bench use, reverse the above procedure.

2.3 RELAY-RACK MOUNTING.

The 1383-9701 (rack-mounted) Random-Noise Generator is delivered completely assembled in a metal cabinet ready for mounting in an EIA standard 19-inch relay rack. (If desired, the OUTPUT connector on the front panel of the relay-rack model can be moved to the rear panel. Refer to paragraph 2.4).

To install the rack model in a relay rack, slide the instrument (in its cabinet) into the rack and lock it in place with the four 9/16-inch screws (E, Figure 2-2) with captive nylon cup washers. Use two screws on each side and tighten them by inserting a screwdriver through the holes (F) in the handles.

To convert the rack model to a bench model, remove the rack-adaptor set by reversing the procedure of paragraph 2.2.

2.4 MOVING THE OUTPUT CONNECTOR.

To move the OUTPUT connector to the rear panel (see Figure 8-2):

a. Loosen the two captive screws at the rear of the instrument (6, Fig. 1-2), and remove the instrument from its cabinet.

b. Remove and save the gray cover plate (P/N 0480-2470) from its hole in the rear panel.

c. Remove the four screws that hold the OUTPUT connector in the front panel.

d. Move the connector to the rear panel. Pull the rubber grommets from the keyhole-shaped slots they are in, slide them along the cable as necessary, and press them into the other slots so that the cable easily reaches the rear panel (see Figure 8-2).

e. Use the four screws to fasten the connector into the rear panel. (The wider pair of outer-conductor contacts are usually aligned vertically.)

f. Press the snap plug removed in step b into the hole in the front panel to serve as a cover.

g. Place the instrument back in its cabinet, and tighten the two screws at the rear of the instrument.

h. To replace the connector in the front panel, reverse the above procedure.

2.5 CONNECTING THE POWER.

The wiring of the power transformer can be switched, by means of the 2-position slide switch (4, Figure 1-2) on the rear panel, to accept 50- to 400-Hz line power of either 100-125 V or 200-250 V.

Connect the three-wire power cable (P/N 4200-9622, supplied) to the line and to the 3-terminal male connector (5, Figure 1-2) on the rear panel. One 0.3-A fuse and one 0.6-A fuse are used for either line voltage. Power consumption is approximately 35 W.

Properties of Random Noise – Section 3

3.1 DEFINITIONS.

The acoustical term "noise" was applied originally to certain electrical signals because of the undesirable audible effects they produced at the output of radio receivers. Noise, in the electrical sense, is now a broad term that means any unwanted signal, and therefore can include not only input-stage noise and atmospheric noise in radio receivers, but also crosstalk, hum, and distortion.

Random noise is a signal whose exact value at any future moment cannot be predicted. It is even a little more than that; it means a signal containing no periodic component whose future value can be predicted. Unlike periodic signals, whose spectra consist of one or more discrete lines corresponding to the various frequency components, random noise has a spectrum that is a continuous function of frequency, containing no discrete line components.

3.2 DESCRIPTION OF RANDOM NOISE.

It is only possible to describe random noise in terms of its average properties that cannot be measured instantaneously but must be averaged over some finite measurement time. The two most important characteristics of random noise are its amplitude distribution and its spectrum.

3.3 AMPLITUDE DISTRIBUTION.

3.3.1 Amplitude Distribution Functions.

The instantaneous value of a random noise, at some particular instant, cannot be predicted, but for many noises we can speak of the probability that the voltage will lie in some particular range. This probability is given by a function called the amplitude density distribution, p(v). When multiplied by a voltage increment, dv, this function gives the probability that, at any given instant, the voltage lies between v and v + dv. Because the voltage must exist at some value, it follows that the integral

$$\int_{-\infty}^{\infty} p(v)dv = 1.$$

Another useful probability function is the integral over part of that range, called the amplitude distribution, P(v), defined as

$$P(v) = \int_{-\infty}^{v} p(x)dx.$$

Thus defined, P(v) is the probability that the voltage, at any given instant, lies below the value v. The values of these probability functions lie on a scale between 0 and 1, with 1 denoting certainty. A probability of 0.5 denotes a 50% chance of occurance.

3.3.2 The Gaussian Distribution.

The Gaussian or normal distribution is particularly important for several reasons: It describes the "normal" occurrance of random measurement errors in experiments. The amplitude of thermal noise in a resistance and shot noise in a vacuum tube are Gaussianly distributed. The distribution of the sum of many independent time-varying voltages approaches the Gaussian distribution in the limit as the number of such voltages is increased, regardless of the distribution of the individual voltages (derived from the Central Limit Theorem of statistics). An extension of this reasoning leads to the result that filtering that reduces the bandwidth generally makes a non-Gaussian noise more Gaussian, so that, in this sense, the Gaussian is a stable distribution. For these reasons, the Gaussian distribution is of fundamental importance and is the most appropriate distribution of random noise in most experiments. For the Gaussian distribution,

$$p(v) = \left(\frac{1}{\sigma\sqrt{2\pi}}\right) e^{-\frac{v^2}{2\sigma^2}}$$

and

$$P(v) = \frac{1}{2}\left[1 + \text{erf}\left(\frac{v}{\sigma\sqrt{2}}\right)\right]$$

where σ is the root-mean-square voltage (in statistics, the standard deviation), and erf denotes the error function. Values of these functions are given in Table 3-1 and the functions are graphed in Figures 3-1 and 3-2.

TABLE 3-1
Gaussian amplitude distribution functions.

v	p(v)	P(v)
-5σ	$.000\,001\,487/\sigma$	.000 000 287
-4σ	$.000\,133\,8/\sigma$	.000 031 67
-3σ	$.004\,432/\sigma$	.001 350
-2σ	$.053\,99/\sigma$	.022 75
-1σ	$.241\,97/\sigma$	.158 65
0	$.398\,94/\sigma$	.500 00
1σ	$.241\,97/\sigma$	.841 34
2σ	$.053\,99/\sigma$	.977 25
3σ	$.004\,432/\sigma$	.998 650
4σ	$.000\,133\,8/\sigma$	.999 968 33
5σ	$.000\,001\,487/\sigma$	.999 999 713

It can be seen from Figure 3-2 that a Gaussianly distributed random noise lies below its positive root-mean-square value (σ = 1) 84% of the time, and therefore exceeds that value only 16% of the time.

3.3.3 Importance of Knowing the Distribution.

Knowledge of the amplitude distribution of a noise is important in measuring its magnitude. Electronic voltmeters respond to different measures of the amplitude of the voltage, such as the rms, the peak, or the (full-wave-rectified) average. The peak and average values of various waveforms having 1-volt, rms, amplitude are given in Table 3-2. A voltmeter responding to the average and calibrated to indicate the rms value of a sine wave will, when measuring Gaussian noise, indicate a value that is low by the factor 0.798/0.900 = 0.887 (-1.05 dB)[1]. Voltmeters that respond to the true rms value are quite appropriate for the measurement of noise, because they can indicate the rms value without correction, regardless of the amplitude distribution.

TABLE 3-2
Rms, peak, and full-wave rectified average voltage values of various waveforms.

	RMS	PEAK	FULL-WAVE RECTIFIED AVERAGE
Sine Wave	1.0	1.414 ($\sqrt{2}$)	0.900 $\left(\frac{2\sqrt{2}}{\pi}\right)$
Square Wave	1.0	1.0	1.0
Gaussian Noise	1.0	∞	0.798 $\left(\sqrt{\frac{2}{\pi}}\right)$

The response of a peak-indicating voltmeter is dependent upon the charging and discharging time constants of its rectifier circuits; when random noise is measured, each type of peak-responding voltmeter may indicate a different value. The response time of a rectified-average-responding voltmeter is, in practice, often shorter than that of a true rms voltmeter, and it can be used with the correction factor cited above. However, for measurements without the correction factor, or for meas-

[1]This and much other information concerning random noise is contained in a General Radio publication, "Useful Formulas, Tables and Curves for Random Noise", Instrument Note 1N-103 (June, 1963). A copy of this six-page compedium can be obtained free of charge by writing to General Radio, West Concord, Mass., 01781.

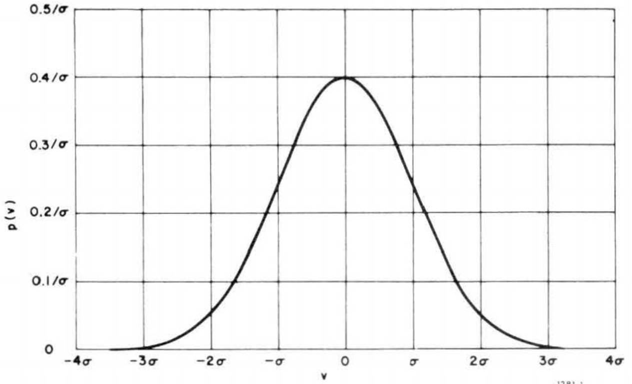


Figure 3-1. The Gaussian probability density function of σ, the root-mean-square amplitude.

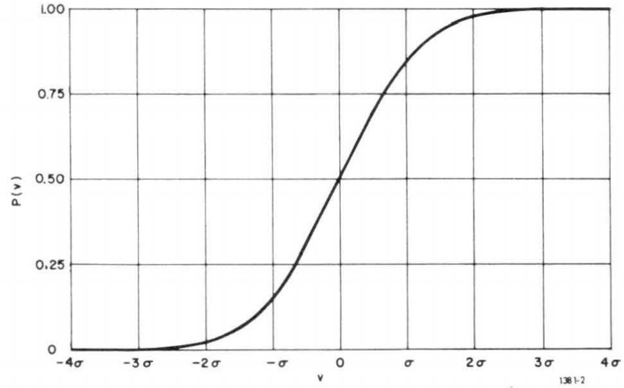


Figure 3-2. The Gaussian probability distribution function plotted as a function of σ, the root-mean-square amplitude.

urements on non-Gaussian noise, it is necessary to use a true-rms instrument.

3.3.4 Measuring Amplitude Distribution.

The amplitude distribution, P(v), can be measured by means of a circuit that measures the percentage of time during which the noise voltage exceeds (or does not exceed) the voltage level, v. Apparatus for this purpose generally includes some form of level-crossing detector and, for high-speed operation, Schmitt-circuit wave-shapers. The measurement must be made by averaging over a time long enough to smooth the fluctuations in the indication to negligible size.

The amplitude density distribution, p(v), can be measured by similar, but somewhat more complicated, apparatus that indicates the percentage of time that the noise voltage exists within the range from v to (v + dv). In making any of these measurements, averaging is important, bacause only the average characteristics of the noise can be measured meaningfully.

In the present state of the art, level-crossing detector circuits cannot be made to operate fast enough for measurements on random noise containing such high frequencies as those produced by the 1383. However, measurements can be made by sampling the noise at a lower-frequency rate, such as 50 or 100 kHz. If the sampling efficiency is unity, the sampled-and-held waveform has the same amplitude distribution as the high-frequency random noise, but it contains much lower frequency components, and it can be applied successfully to the level-crossing detector circuits mentioned above.

3.3.5 Amplitude Distribution of the Type 1383.

The noise source used in the 1383 is a thermionic diode. The noise is generated as shot noise in the plate current of the diode, the amplitude distribution of which is definitely Gaussian, because the total current is the sum of a very large number of independent pulses.[2] The amplifiers in the 1383 have been specially designed so that, at full output amplitude, pulses below 3σ will not be clipped.

3.4 SPECTRUM.

3.4.1 General.

The spectrum of a random signal is different from that of a periodic signal, which is composed of one or more discrete lines, each of which corresponds to a frequency component of the periodic signal. A truly random signal contains no periodic frequency components, and has a spectrum that is a continuous function of frequency.

3.4.2 Spectrum Functions.

The frequency content of a random noise is described by a function called the spectral intensity, which has the dimensions of voltage squared per unit bandwidth. (When divided by a value of resistance, it is equal to the power that voltage would dissipate in that resistance, per unit bandwidth). The spectral intensity is the Fourier transform of the autocorrelation function, and is the spectrum function most often used in mathematical analysis of random noise. It is not the most convenient function for practical use, however, because spectra are usually measured as voltage, rather than voltage squared, in a given bandwidth, and filter responses, used in shaping noise spectra, are usually measured as voltage functions. Therefore, for practical use, we define the voltage spectrum as numerically equal to the square root of the spectral intensity. It has units of voltage per square root of bandwidth, but may be spoken of as voltage in a given bandwidth. Spectra shown in Figure 3-3 are plotted as voltage spectra.

3.4.3 White Noise.

Noise whose spectral intensity is constant over a range of frequencies is called white noise, by analogy with white light, which contains more or less equal intensities of all visible colors.[3] White noise cannot contain equal amplitudes at all frequencies, for then the total power in the noise would be infinite. White noise, therefore, means that the spectrum is flat over the range of interest, for example, throughout the audio-frequency range. Because of its flat spectrum, white noise is particularly convenient as a starting point for many experiments.

3.4.4 Importance of Knowing the Spectrum.

In most experiments involving random noise, knowledge of the spectrum of the noise being used is vitally necessary. When noise is used as a driving-point signal to determine the response of some system, the response is meaningful only when the input spectrum is known, and is usually most conveniently studied when the input spectrum is flat. There are, of course, cases where other spectra are more convenient. If, in such cases, a filter can be constructed whose response has the shape of the desired spectrum, white noise is the proper input for that filter to produce the desired spectrum at its output.

3.4.5 Noise-Spectra Measurements.

The spectrum of a noise can be measured with any wave analyzer whose frequency range is appropriate. For the output indication to be free of fluctuations that might cause reading errors, the product of analysis bandwidth and the averaging time must be large. As in the measurement of the amplitude distribution, the spectrum can only be measured accurately by averaging over a relatively long time interval.

Wave analyzers generally indicate the voltage in the analysis passband. The indication is therefore proportional to w(f), not W(f). It is convenient to reduce all measurements to a

[2]Bennett, W.R., "Electrical Noise", McGraw-Hill Book Co., New York (1960), p.40.

[3]Although, as Bennett (op.cit., p. 14) points out, the analogy has been drawn incorrectly, because spectroscopists were measuring intensity as a function of wavelength, and found it to be substantially constant per unit wavelength, not per unit frequency.

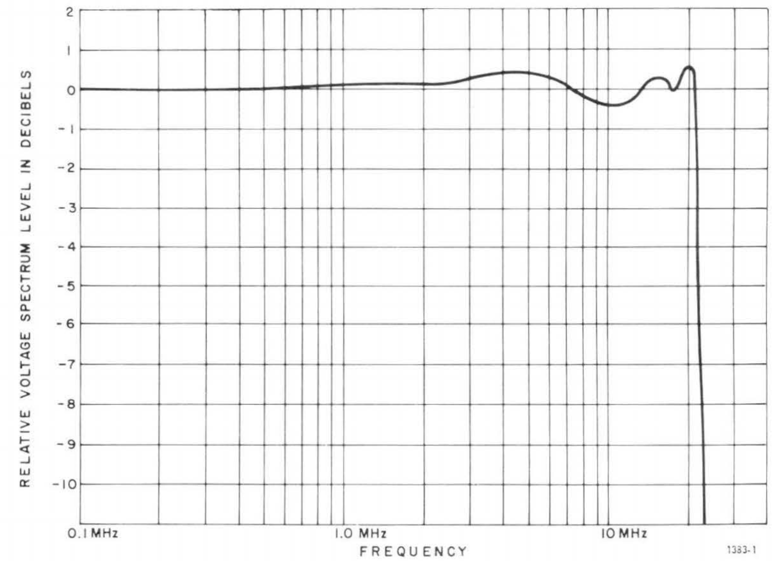


Figure 3-3. Typical voltage spectrum of the 1383 Random-Noise Generator.

common bandwidth basis, and the most-often-used bandwidth is one cycle. Units for W(f) are "volts squared per cycle bandwidth," and considerable use has been made of the unit "volts per root-cycle" for w(f). Now that "cycles" have become "hertz," this term is even more cumbersome, and is perhaps best replaced by "volts in a 1-hertz band."

In order to convert to volts in a 1-hertz band, it is necessary to divide the voltage indication of the analyzer by the square root of the analysis bandwidth. For example, using the General Radio Type 1900 Wave Analyzer, multiply by the factors given in Table 3-3 to convert measured values of random noise to volts in a 1-hertz band.

TABLE 3-3
Correction factors for converting voltage indication of the Type 1900 Wave Analyzer to voltage in a 1-hertz band.

ANALYZER BANDWIDTH	CORRECTION FACTOR[4]
3 Hz	0.650 (-3.7 dB)
10 Hz	0.357 (-9.0 dB)
50 Hz	0.159 (-15.9 dB)

[4]These numbers include the correction for the average-responding voltmeter in the 1900 Wave Analyzer.

In a constant-percentage-bandwidth analyzer, the analysis bandwidth is directly proportional to the center frequency of the pass band. This necessitates dividing the voltage indication by the square root of the frequency as well as by the correction factor for the fractional bandwidth itself. When using constant-percentage-bandwidth analyzers, such as the General Radio Type 1564 Sound and Vibration Analyzer or the Type 1558 Octave-Band Analyzer, multiply the analyzer voltage indication by the appropriate conversion factor in Table 3-4.

TABLE 3-4
Correction factors for converting voltage indication of a constant-percentage-bandwidth analyzer to voltage in a 1-hertz band.

BANDWIDTH	CORRECTION FACTOR
1/10 Octave	$3.80/\sqrt{f}$
1/3 Octave	$2.08/\sqrt{f}$
1 Octave	$1.19/\sqrt{f}$

3.4.6 Spectrum of the Type 1383.

The noise produced by the Type 1383 is white over a wide range of frequencies; the voltage spectrum is flat within ±1 dB for frequencies from 20 Hz to 10 MHz, and within ±1.5 dB for frequencies from 10 to 20 MHz. A typical spectrum is shown in Figure 3-3. The spectrum is cut off very sharply at 20 MHz, so that the effective bandwidth of the noise is quite closely 20 MHz. At the open-circuit output amplitude of 1 V, the voltage spectrum level is 224 μV in a 1-Hz bandwidth.

3.5 STATIONARITY.

A random noise is said to be stationary[5] if its various statistical parameters, such as the amplitude distribution and the spectral intensity, do not change with time. Random noise, of course, never repeats the same pattern from one moment to the next, but, if it is stationary, many measurements of the spectrum made at different times will all indicate the same result, except for the unavoidable errors of measuring a random quantity in a finite time. In discussing tests for stationarity, Bendat and Piersol[6] point out that, for most noise-generating

[5]Bennett, op. cit., p. 52-54.

[6]Bendat, J.S., and Piersol, A.G., *Measurement and Analysis of Random Data*, John Wiley and Sons, Inc., New York, 1966, pp. 219-223.

processes, it is sufficient to determine that the mean and the variance (square of the standard deviation, σ) do not change with the time at which they are measured. Because the output of the 1383 is ac coupled, the mean is automatically zero, and it is only necessary to observe the rms amplitude to prove stationarity. This can be done by seeing that the fluctuations in long-time recordings of the amplitude of the noise are no greater than the value predicted from the bandwidth of the noise and the smoothing time of the detector.

The importance of stationarity in a random-noise generator is analogous to stability in an oscillator; the user is assured that there is no change in the spectrum or the amplitude distribution during the course of an experiment. The stationarity of the noise output of the 1383 comes, first of all, from its noise source; the temperature-limited thermionic diode has long been recognized and used as a standard noise source for noise-figure measurements of high-frequency amplifiers.[7] The noise current it produces is proportional to the square root of the dc plate current, which, in the 1383, is held constant by feedback controlling the filament current. The gain of the noise-current amplifiers is stabilized by feedback.

[7]Spangenberg, K.R., *Vacuum Tubes*, McGraw-Hill Book Co., Inc. New York, 1948, p. 307.

3.6 SUMMARY.

Because various terms used in speaking of random noise are sometimes confused, a summary is presented here of the most-often-used words, together with a brief explanation of their meaning: "Noise" is any unwanted signal. "Random noise" is a signal whose future value cannot be exactly predicted and that does not contain any periodic components. To differentiate clearly between the spectrum and the amplitude distribution, in this book the word "density" is used only in connection with the amplitude distribution. The word "intensity" is used only in connection with the spectrum. "Gaussian" applies only to the amplitude distribution and refers to a particular theoretical distribution. "White" refers only to the spectrum, and means that the spectral intensity is constant over some range of interest.

Principles of Operation—Section 4

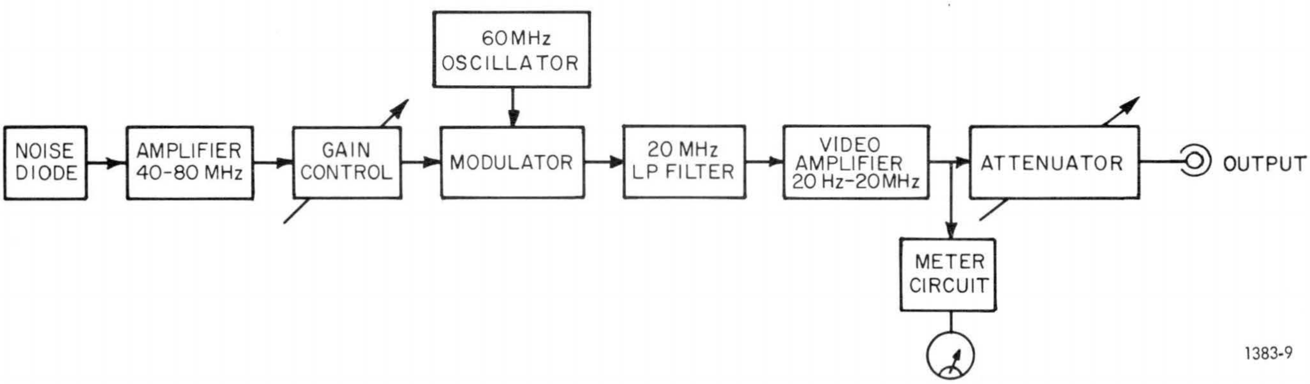


Figure 4-1. Block diagram of the 1383 Random-Noise Generator.

4.1 DESCRIPTION OF CIRCUIT.

Figure 4-1 is a block diagram of the Type 1383 Random-Noise Generator. The noise source is a thermonic diode operated in the temperature-limited mode. The noise output of such a diode operated in this way is exactly Gaussian, it is spectrally flat to extremely high frequencies, and its level is proportional to the square root of the dc plate current. To keep the amplitude stable, the filament current of the noise diode is controlled by feedback, to maintain a constant current. The noise output of the diode is amplified in the frequency range from 40 to 80 MHz. By heterodyning against a 60-MHz local oscillator, the noise frequency is translated to the 0-to-20-MHz band. A sharp-cutoff low-pass filter ensures that higher noise frequencies and residual local-oscillator signals are removed. An ac-coupled amplifier is used to increase the power of that noise to the output level of 1 V. The voltmeter (which indicates the output level) and the output attenuator complete the circuit. All power supplies are regulated except the plate supply to the noise diode.

Operating Procedure—Section 5

5.1 GENERAL.

With the instrument in position on the bench or installed in a relay rack, set the screwdriver-operated slide switch S502 (4, Figure 1-2) to the range corresponding to the power-line voltage. Connect the instrument to the line power, using the power cable supplied (P/N 4200-9622), and turn on the POWER switch.

Follow the instructions given in paragraphs 5.2 and 5.3 for setting the OUTPUT LEVEL and METER FULL SCALE controls.

5.2 OUTPUT LEVEL CONTROL.

The OUTPUT LEVEL control is a continuous rotary control by means of which the output level can be set at any selected value between its maximum open-circuit value and zero. The open-circuit output voltage is indicated by the meter on the front panel, which must be read on the scale appropriate to the setting of the output attenuator (the METER FULL SCALE control).

5.3 METER FULL SCALE CONTROL.

The METER FULL SCALE control is the output attenuator and permits reduction of the output-voltage level by 80 dB from its maximum, in 10-dB steps. The voltage indicated is the open-circuit output voltage; when the output is loaded by 50 Ω, the output voltage is reduced by half. Decibel readings on the dial of the METER FULL SCALE control can be added to the decibel indication of the meter to obtain the open-circuit output voltage in decibels below 1 V.

5.4 OUTPUT CONNECTIONS.

The output connector on the front panel is a GR874, locking-type, coaxial connector. Generally, the output should be taken by means of a mating GR874 connector into a closed coaxial system. Adaptors to other types of high-frequency connectors are available (refer to Table 1-4). The output connector can be moved to the rear panel if more convenient, as when the instrument is mounted in a relay rack (refer to paragraph 2.4 and Figure 8-2).

5.5 OUTPUT IMPEDANCE.

The output impedance of the 1383 is 50 ohms, ±2%. The output can be short circuited without causing distortion of the output current. The maximum output current into a short circuit is 20 mA, rms, with occasional peaks that may exceed four times that value.

5.6 MODIFYING THE OUTPUT.

5.6.1 Producing Lower Levels.

GR874-G fixed coaxial attenuators (refer to Table 1-4) in reducing the output level beyond the range of the 1383 output attenuator (the METER FULL SCALE control). These units are available with attenuations of 3, 6, 10, 14, and 20 dB. They are designed for insertion in a 50-ohm line.

5.6.2 Generating Bands of Noise.

It may be necessary to restrict the bandwidth of the noise output of the 1383. For inserting a tuned circuit or filter in series with the 50-ohm output, it may be convenient to use the GR874-X insertion unit, which permits totally-shielded connection of any circuit that will fit in its 2-inch long, 9/16-inch-diameter space.

5.6.3 Generating Higher Levels.

The noise generated by the 1383 Random-Noise Generator can be amplified by any amplifier whose frequency range is adequate. The high crest factor of Gaussian noise must be kept in mind in choosing the power rating of the amplifier so that the noise will not be clipped. In order that peaks of 3σ be passed without clipping, the amplifier must be capable of amplifying a sine wave without distortion to a power level 4.5 times greater than the average noise power desired.

5.6.4 Generating Noise at Higher Frequencies.

Noise at higher frequencies can be generated by using a double-balanced mixer to modulate a high-frequency carrier from an oscillator or signal generator. The result will be a band of noise 40 MHz wide, centered on the carrier frequency. (There will be a notch 40 Hz wide at the carrier frequency.[1]) The degree of discrimination against the carrier and the upper carrier frequency that can be used will depend upon the characteristics of the mixer used. Many such mixer units are commercially available.[2]

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[1]Perhaps wider, depending upon the characteristics of the mixer.

[2]Relcom, E. G., Mountain View, Cal.

Applications – Section 6

6.1 GENERAL.

The Type 1383 Random-Noise Generator is useful wherever a broad-band, high-level source of white noise is needed. Its 50-ohm output impedance and spectral intensity that is substantially constant to 20 MHz make it particularly useful at radio frequencies.

For audio-frequency applications, Types 1381 and 1382 Random-Noise Generators[1] may be found to be more useful. They are intended for applications in the fields of acoustics, electroacoustics, psychoacoustics, and vibration analysis, in addition to their general use as **audio-frequency** generators of random electrical noise.

6.2 SIMULATION OF BACKGROUND NOISE.

In studying the performance of radio, telemetry, radar or sonar systems with regard to their ability to transmit, detect, and recover signals in noise, it is convenient to simulate the real mixture of signal and naturally occurring noise by adding noise of controlled characteristics to a standard signal. Noise sometimes becomes the signal itself in tests of correlation receivers and other modern signal-processing systems.

A mixture of signal and noise can be created by adding the output of a signal generator (possibly modulated in some appropriate manner) to the noise from the 1383. This can be accomplished with the GR874-TPD or GR874-TPDL Power Divider (see Table 1-4), with which signals in two 50-ohm systems can be added together. Noise that has been heterodyned to higher frequencies (see paragraph 5.6.4) can be used for this purpose.

6.3 MEASURING INTERMODULATION DISTORTION.

Random noise is used in one very effective method of measuring intermodulation distortion.[2] White noise, which has been passed through a band-stop filter that reduces the level of the noise by, say, 80 dB over a narrow range of frequencies, is applied to the input of a system. Spectrum measurements of the system output indicate how much the "notch" in the noise spectrum has been filled in by intermodulation products. This is an especially significant measurement because white noise contains all the frequencies to which the system responds, and represents, in this sense, a "worst-case" type of test signal.

6.4 MEASURING CROSSTALK.

White noise is a very appropriate signal for use in measuring crosstalk in multichannel telephone, radio, or telemetry systems. Spectrum analysis of the crosstalk signal identifies the frequencies that cause the greatest disturbance, thereby providing some assistance in determining the cause and specifying a cure.

6.5 MEASUREMENT OF EFFECTIVE BANDWIDTH.

When wave analyzers or filters (or more complex systems) are used to measure the spectral density of noise, it is necessary to know the effective bandwidth of the filter or of the system. The effective noise bandwidth can be thought of in terms of an ideal filter having a rectangular frequency characteristic (constant over a range of frequencies, and zero everywhere else). The effective noise bandwidth of a filter is the width of the pass band of the ideal filter whose output is exactly equal to the output of the actual filter when the inputs are the same white noise, provided the maximum transmissions of the two filters are the same. It can be measured by finding the total signal transmitted when white noise of known spectral level is applied to the input. The frequency range of the white noise must include all frequencies for which the filter being measured has appreciable transmission.

When the effective bandwidth of the input noise is known, the necessary computations are simplified. Then the

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[1] Faran, J.J., Jr., "Random-Noise Generators", General Radio *Experimenter* Vol. 42, No. 1, pp. 3-13 (January, 1968).
[2] MIL STD-188B.

effective bandwidth of the filter is

$$EBW_f = EBW_n \left(\frac{N_{out}}{N_{in} G_{fmax}}\right)^2$$

where EBW_n is the effective bandwidth of the noise;

N_{out} is the output noise voltage;

N_{in} is the input noise voltage;

G_{fmax} is the maximum or peak gain of the filter (as measured with a sine-wave signal).

The effective bandwidth of the noise output of the 1383 is very close to 20 MHz. In measuring the output voltage, it should be kept in mind that the voltmeter used should respond accurately to frequencies as high as 20 MHz and its operation (average, peak, or rms) should be known (refer to paragraph 3.3.3). The voltmeter should not be connected at the end of an unterminated cable, but should either terminate the cable (if a 50-ohm input adaptor is available) or should be bridged onto a terminated cable.

6.6 NOISE TEMPERATURE.

6.6.1 Definition.

It is sometimes convenient to express the noise level in a circuit in terms of **noise temperature.** The noise voltage across a resistance due to thermal agitation of the free electrons in it (thermal noise) is

$$e_n = \sqrt{4kTRB} \quad ,$$

where e_n is the rms noise voltage,
k is Boltzmann's constant (1.38×10^{-23} joules/°K),
T is the absolute temperature of the resistance in °K,
R is the resistance in ohms,
and B is the bandwidth in hertz in which the noise is being observed.

When an artificially-generated noise voltage, e_a, is impressed across a resistance, it adds to the thermal noise whose amplitude is given above. It is then possible to define **noise temperature** as that temperature at which the thermal noise power would equal the total noise power[3]:

$$T_n = \frac{e_n^2 + e_a^2}{4RB} \quad . \qquad (6\text{-}1)$$

Because noise temperature depends upon the square of the noise voltage, such values can become extraordinarily large; for example, the noise temperature of the output of the 1383 at full output is 1.8×10^{13} °K. Noise temperature is most useful in describing the equivalent input noise of high-frequency receivers and amplifiers, where, incidentally, for certain types of circuits, the equivalent input noise temperature (see below) is considerably lower than the ambient temperature.

The noise temperature of the output of the 1383 can never be less than its actual temperature, because its output circuits are comprised of real resistances. Figure 6-1 shows how the noise temperature of the output varies with the amount of attenuation when the OUTPUT LEVEL control is set so that the meter indicates full scale. Attenuation up to 80 dB is available with the METER FULL SCALE control; additional attenuation must be obtained with external attenuators such as GR 874-G units (refer to paragraph 5.6.1). As is readily apparent, the noise temperature levels off at 290°K (23°C) as the attenuation is increased (assuming the noise generator and attenuators are at 23°C).

6.6.2 Measurement of Effective Input Noise Temperature.

The **effective input noise temperature** of a receiver or amplifier is the temperature at which the resistive component of the input source would generate an amount of noise exactly equal to that arising in the receiver or amplifier only. One procedure for measuring the effective input noise temperature involves knowledge of the effective noise temperature of a source under both hot (**on**) and cold (**off**) conditions.[4] For amplifiers intended for operation from a 50-ohm source, the effective noise temperature of the output of the 1383 when **on** can be read from Figure 6-1 or calculated from equation 6-1, paragraph 6.6.1. The effective noise temperature when the noise generator is **off** is the temperature of the noise generator (and its output attenuators). Normal room temperature (290°K) is often a close-enough approximation.

The measurement is made by connecting a noise generator to the receiver and measuring the output power when the noise generator is cold **off** and hot **on.** The effective input noise temperature is then

$$T_{eff} = \frac{T_{ih} - (P_{oh}/P_{oc})\, T_{ic}}{(P_{oh}/P_{oc}) - 1} \quad ,$$

where T_{ih} is the noise temperature of the source when it is hot (**on**),
T_{ic} is the noise temperature of the source when it is cold (**off**),
P_{oh} is the output power when the source is hot (**on**),
and P_{oc} is the output power when the source is cold (**off**).

[3]More complicated (and more precise) definitions are given in "IRE Standards on Electron Tubes: Definitions of Terms, 1962 (62 IRE 7.S2)", *Proc. IEEE 51*, pp. 434-435 (March, 1963).

[4]For an excellent discussion of noise temperature and noise-figure measurements, refer to Mumford, W.W., and Scheibe, E.H., *Noise Performance Factors in Communication Systems*, Horizon House - Microwave, Inc., Dedham, Mass. (1968).

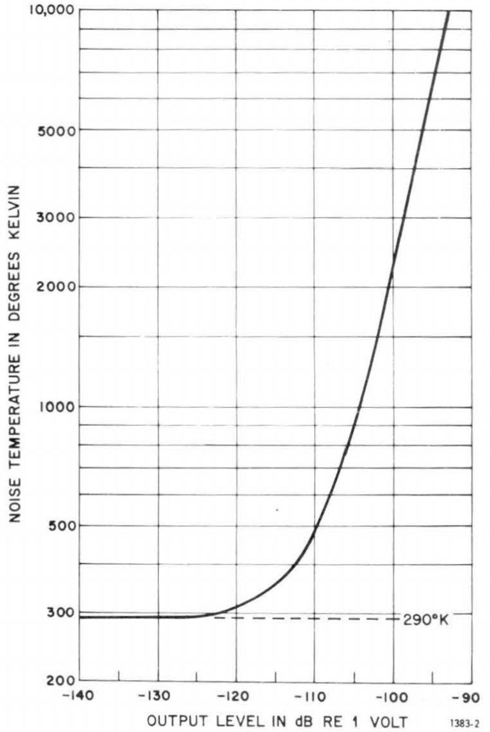

Figure 6-1. Noise temperature at the output connector of the 1383 as a function of the level in dB re 1 V, rms. Output impedance 50 Ω, temperature 23°C (290°K). Additional attenuation beyond 80 dB provided externally.

6.7 NOISE FACTOR OR NOISE FIGURE.

6.7.1 Definitions.

The **noise factor**, F, of a receiver or amplifier is the ratio of the total output noise power to that portion of the output power that is due to thermal noise in the source.[5] It is thus the amount by which the output noise is increased because of noise in the amplifier over what it would be if the thermal noise in the source was amplified by a perfect (noise-free) amplifier. In generally accepted useage, "**noise figure**" is the noise factor expressed in decibels,[6] i.e., "noise figure" is 10 log F.

6.7.2 Measurement of Noise Factor or Noise Figure.

The simplest and most convenient method of measuring the noise factor of a receiver or amplifier is usually by use of a noise generator. The measurement is similar to that used in the determination of effective input noise temperature. The noise factor is

$$F = \frac{\left(\frac{T_{ih}}{290} - 1\right) - (P_{oh}/P_{oc})\left(\frac{T_{ic}}{290} - 1\right)}{(P_{oh}/P_{oc}) - 1},$$

where T_{ih} is the noise temperature of the source when it is hot (on),

T_{ic} is the noise temperature of the source when it is cold(off),

P_{oh} is the power output when the source is hot (on),

and P_{oc} is the power output when the source is cold (off).

When T_{ic} is 290°K, the formula simplifies to

$$F = \frac{\frac{T_{ih}}{290} - 1}{\frac{P_{oh}}{P_{oc}} - 1}.$$

For more detailed discussion of noise factor and noise figure and the measurement thereof, the reader is referred to the literature, footnotes 4 and 5, this section.

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[5] More complicated (and more precise) definitions are given in Haus, H.A., et al, "Description of the Noise Performance of Amplifiers and Receiving Systems", *Proc. IEEE 51*, PP. 436-442 (March, 1963), Appendix.

[6] Mumford and Schiebe, op.cit., p. 69.

Service and Maintenance—Section 7

7.1 SERVICE.

Our two-year warranty attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department (see rear cover), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the type serial and ID numbers of instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest District Office, requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

7.2 MINIMUM PERFORMANCE STANDARDS.

7.2.1 General.

The two most important items to be measured in checking a noise generator for conformance to specifications are the spectrum and the amplitude distribution. Both of these are complicated and tedious measurements, requiring a number of pieces of equipment. Instruments have been constructed especially for this purpose at General Radio and are used in checking noise generators before they are shipped. The performance of this specially constructed equipment is not readily duplicated by commercially available instruments. However, given below are lists of equipment and instructions for checking these characteristics as well as possible, with readily available apparatus.

7.2.2 Checking the Spectrum.

General.

The spectrum of the noise output of the 1383 covers an extremely wide frequency range (20 Hz to 20 MHz). No single wave analyzer covers this range. Measurements, therefore, must be made with several analyzers that may operate in different ways, particularly with regard to bandwidth and detector characteristics. Because of the difficulties of calibrating some of them, it is recommended that the analyzers be used to check the flatness of the spectrum, rather than to make absolute determinations of the voltage spectrum level at each frequency.

Spectrum.

A list of equipment that can be used to check the flatness of the spectrum of the 1383 is given in Table 7-1. Connect the output of the 1383 to the input of either the Rhode & Schwarz Type USVH Selective Microvoltmeter (Figure 7-1) or the Hewlett Packard Model 312A Wave

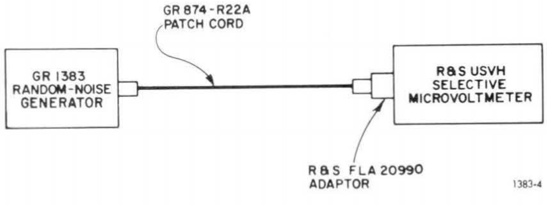


Figure 7-1. The R & S USVH Microvoltmeter can be used to check the flatness of the spectrum from 25 kHz to 20 MHz.

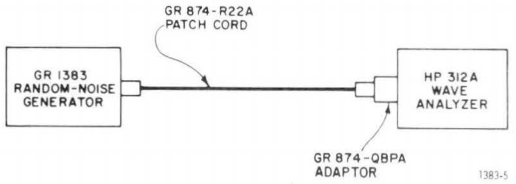


Figure 7-2. The spectrum flatness can be checked from 25 kHz to 18 MHz with the HP model 312A Wave Analyzer.

Analyzer (Figure 7-2), and set the input impedance at 50 Ω. With the full 1-V, rms, output of the 1383, the voltage delivered to the 50 Ω load of the analyzer will be 0.5 V. Set the attenuators of the wave analyzer accordingly, and tune across the range from 25 kHz to 20 MHz (necessarily stopping at 18 MHz in the case of the HP-312A). Record the meter indications as a function of frequency. This is the voltage spectrum level on an arbitrary scale.

To measure the spectrum at frequencies below 20 kHz, use the GR Type 1564 Sound and Vibration Analyzer connected as shown in Figure 7-3. The bandwidth of the noise should be reduced before it is connected to the 1564. The simple filter shown in Figure 7-4 can be constructed in a GR 874-X Insertion Unit for this purpose. This filter is designed for operation from a 50-ohm source into an open circuit (impedance high compared to 50 ohms). Place this filter at the output of the 1383 and connect it to the input of the 1564 by a shielded cable. (Use an 874-Q2 Adaptor and a 1560-P95 Adaptor Cable. See Table 1-4.) A measurement made at 25 kHz (in the 1/3-octave band) corresponds to the level measured with the high-frequency wave analyzer, and provides the transfer to a new arbitrary scale for this analyzer. The 1564 is a constant-percentage-bandwidth analyzer. Subsequent voltage

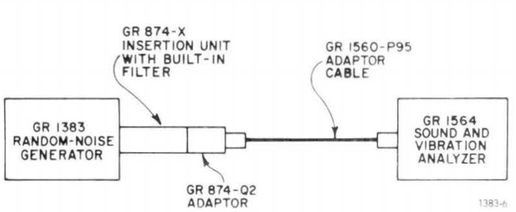


Figure 7-3. Connections for checking the spectrum at frequencies below 20 kHz.

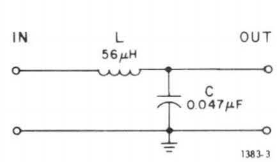


Figure 7-4. Low-pass filter to be built into a GR874-X Insertion Unit and used with a 50-Ω Termination Unit.

measurements made at lower frequencies must be multiplied by the factor $\sqrt{25000/f}$ to find the voltage that would be measured by an analyzer having constant bandwidth. The amount by which the resultant number differs from that measured at 25 kHz is the departure from perfect spectral flatness.

7.2.3 Amplitude Distribution.

As mentioned above, specially constructed equipment is used at General Radio for checking the amplitude distribution of noise generators before they leave the factory. Customers familiar with amplitude distribution measurements may have suitable equipment on hand, or at least will understand what sort of equipment is necessary, and how to assemble it. Others must make use of commercially available amplitude distribution analyzers, two of which will be discussed here.

A list of equipment that can be used in checking the amplitude density distribution is included in Table 7-1.

Sampling Unit Necessary.

Regardless of what equipment is used for the measurement, there is one important consideration in connection with the 1383: The bandwidth of the noise produced by it is much too wide for any conventional amplitude distribution measuring equipment. This problem can be overcome by using sampling techniques to reduce the bandwidth of the noise signal while preserving the amplitude distribution characteristics. This is most easily done with a sampling oscilloscope, which makes available as an output the "sampled-and-held" waveform. One such is the Tektronix 1S1 Sampling Plug-in Unit. It should be triggered from an external source of pulses at, say, a 20-kHz rate; the resulting rectangular sampled-and-held waveform is easily processed by amplitude distribution analyzers intended for audio-frequency use.

An important precaution in the use of such a sampling system is that the "sampling efficiency" *must* be adjusted to unity. Otherwise the hold capacitor will not be charged fully to the value of the noise waveform at the sampling instant, and the resulting output at each step will be some sort of average over the previous few samples; the amplitude distribution of the sampled-and-held output will not be representative of the noise. The manufacturer's procedure should be followed in setting the sampling efficiency to unity.

When using the Tektronix 1S1, connect the output of the 1383 by a 50-Ω cable to the 50-Ω input of the sampling unit. To avoid overloading the sampling unit, adequate attenuation should be inserted ahead of the sampler. This can be done conveniently with the output attenuator of the 1383.

It may be necessary to use a buffer amplifier at the output of the sampling unit, ahead of the amplitude distribution analyzer, either to increase the signal amplitude

TABLE 7-1

Equipment required for checking minimum performance standards.

INSTRUMENT	REQUIREMENTS	RECOMMENDED TYPE (or equivalent)
Analyzer	25 kHz - 20 MHz	Rhode & Schwarz Type USVH Selective Microvoltmeter or Hewlett-Packard Model 312A Wave Analyzer (usable to 18 MHz)
Analyzer	20 Hz - 25 kHz	GR Type 1564 Sound and Vibration Analyzer
Low-pass Filter	(See Figure 7-4)	Build in GR874-X Insertion Unit
Sampling Oscilloscope	>100 MHz input bandwidth, 50Ω input impedance, sampled-and-held output available	Tektronix Model 1S1 Sampling Unit in any Tektronix Type 530, 540, or 550 Oscilloscope
Pulse Generator	10-μs pulses at 20-kHz rate	GR Type 1340
Buffer Amplifier	Input impedance >100 kΩ bandwidth >200 kHz, voltage gain of 10, distortion <1%.	Hewlett-Packard Model 465-A
Amplitude Distribution Analyzer		B & K Model 161 or Quan-Tech Model 317
Counter	Counts at 10-MHz rate, multiple-period operation	GR Type 1191

or to lower the impedance of the sampled-and-held signal. If a buffer amplifier is used, it is extremely important that it have low distortion, as even small amounts of non-linear distortion can have a serious effect on the amplitude distribution of a random noise signal.

Use of the B & K Model 161 Amplitude Distribution Analyzer.

The B & K Model 161 Amplitude Distribution Analyzer will measure the amplitude density distribution of random noise. When making such measurements on the output of the 1383, sampling techniques will be necessary. (See above). In conjunction with a sampling oscilloscope, a buffer amplifier will probably be necessary to bring the signal to an adequate level. The amplifier should have distortion well under 1% and bandwidth flat to 200 kHz or more.

Measurements made with the B & K Model 161 should be made according to the manufacturer's instructions. The window width of the Model 161 is 0.1 σ while the specifications of the 1383 are given in terms of a window of 0.2 σ. The specified values, if divided by 2, will give values for a window of 0.1 σ with adequate accuracy. It will not be possible to read the panel meter of the B & K 161 with sufficient accuracy for measurements at 3 σ. Use a counter with the digital output according to the manufacturer's instructions. The test setup is shown in Figure 7-5.

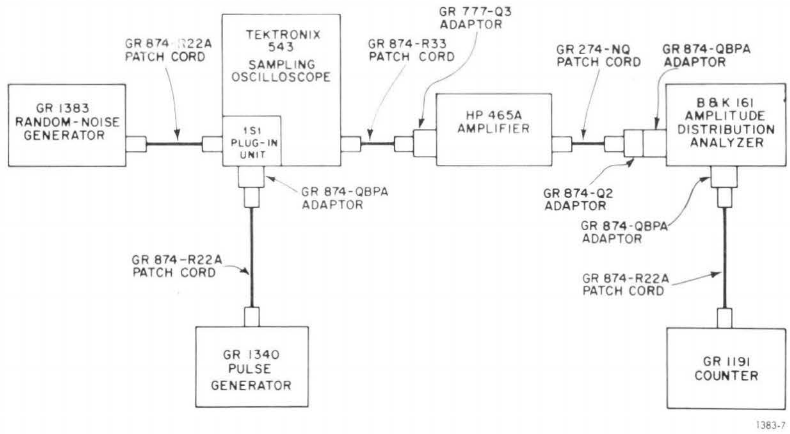


Figure 7-5. Test setup for measuring the amplitude density distribution using the B & K Analyzer.

Use of the Quan-Tech Model 317 Amplitude Distribution Analyzer.

The Quan-Tech Model 317 Amplitude Distribution Analyzer will not measure the amplitude density, but will measure the amplitude distribution. When it is used with the Tektronix Model 1S1 Sampling Unit, no buffer amplifier is necessary. Comparison of measured values of the amplitude distribution function with those for the Gaussian distribution given in Table 3-1 will show how closely the distribution function is Gaussian. Initial adjustment of the input level will have to be made with the front panel ATTEN and VAR ATTEN controls. An adequate way to proceed is to offset the LEVEL control (which sets the value of sigma at which the measurement is made) from its mid-range value by one unit (corresponding to one σ). The full range of this control is plus and minus 5 σ. The attenuators should then be set so that the meter indicates 15.8 percent. Then, if the LEVEL control is turned two units from mid-range, the meter should indicate 2.27%, etc. The manufacturer's instructions will be found helpful. The test setup is shown in Figure 7-6.

7.2.4 Other Tests.

Output Attenuator Accuracy.

The accuracy of the output attenuator can be checked by comparison with some other attenuator such as that in the Rhode & Schwarz USVH Selective Microvoltmeter. The comparison can be made at any frequency within the range of the two instruments, using the noise as the test signal.

Voltmeter Accuracy.

The voltmeter can be checked to its specified accuracy of ±5% by using a Ballantine Model 323 True-rms Voltmeter as a standard. Connect it to the output of the 1383 by a cable that is terminated at the voltmeter with an 874-W50B 50-Ω Termination, using an 874-T Tee and an 874-QBPA Adaptor (GR874 to BNC) to connect to the voltmeter. The termination, located at the voltmeter, ensures that there are no standing waves on the cable. The indication of the Model 323 Voltmeter will be half that of the panel meter (which indicates the open-circuit output voltage). Allow the 1383 to reach thermal equilibrium in its case so that temperature-compensation elements in the meter circuit will operate properly.

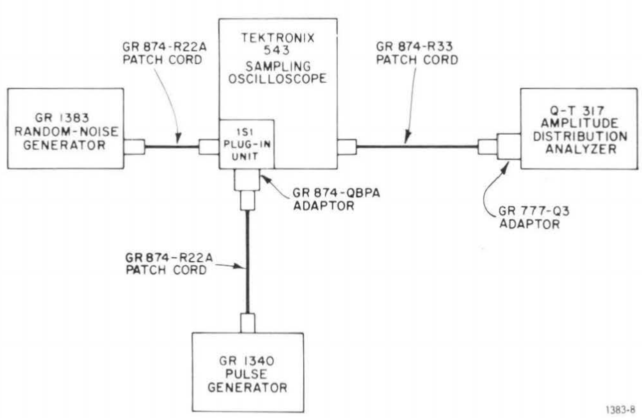


Figure 7-6. Test setup for measuring the amplitude distribution with the Quan-Tech Analyzer.

7.3 RECALIBRATION.

If repairs are made that include the replacement of some components, the internal controls noted below may have to be readjusted (see Figures 8-1 and 8-2). The required test equipment is listed in Table 7-2. Allow a ½-hour warm-up period, with the instrument in the cabinet, before making adjustments.

R525: This potentiometer is adjusted to set the voltage at the output of the regulated +10 V supply. Connect a dc voltmeter from AT531 (negative) to AT530 (positive) and set R525 so that the voltmeter indicates 10 V. The negative 10-V supply is controlled by the positive 10-V supply. If the negative supply is appreciably different from -10 V, measured from AT532 (negative) to AT531 (positive), R525 can be reset slightly to average the two magnitudes about 10 V.

R143: This potentiometer sets the magnitude of the dc plate current in the noise diode, V901, and thereby controls the magnitude of the noise output of the 1383. To set R143, turn the OUTPUT LEVEL control on the front panel fully clockwise and set the potentiometer so that the meter indicates full scale. Then turn the OUTPUT LEVEL control counterclockwise, to reduce the indication of the meter by 1 dB. Reset R143 to return the meter indication to full scale. This sets the noise level so that there is a reserve amplitude of 1 dB beyond full scale under normal conditions.

T202: Adjustment of the core inside this coil varies the frequency of the oscillator. Using a grid-dip meter, set the frequency of the oscillator to 60 MHz,±1MHz. When replacing the cover over the oscillator and modular board, tighten the four screws fairly tight, but not as tight as absolutely possible (the "finger stock" material makes the best grounding connections for shielding when not pressed absolutely flat).

R327: This potentiometer adjusts the dc bias conditions on the output stage, to compensate for different current gains in the output transistors, Q308 and Q309. Using a dc voltmeter, with the OUTPUT LEVEL control turned fully counterclockwise, adjust R327 so that the voltage from the collector of Q309 to ground is 2 V, positive. A further refinement of this adjustment is to observe the amplitude distribution of the noise at full amplitude output and adjust R327 for best symmetry. This is, however, a complicated procedure, and the simpler adjustment given first usually suffices to produce satisfactory results.

R322: This potentiometer adjusts the sensitivity of the voltmeter on the panel. To properly adjust this control, it is necessary to measure the output noise voltage. Connect the output, by means of a 50-Ω cable, to the input of the Ballantine 323 True-rms Voltmeter. The cable should be terminated at the voltmeter by an 874-W50B 50-Ω Termination using an 874-T Tee. An 874-QBPA Adaptor (GR874 to BNC) is useful in making closed connection to the voltmeter. With this arrangement, the cable is terminated in a matched load; therefore, the Ballantine 323 Voltmeter will read half the voltage indicated by the panel meter, which indicates the open-circuit output voltage. After the 1383 has been in its cabinet long enough to reach thermal equilibrium, set the OUTPUT LEVEL control so that the Ballantine Voltmeter reads exactly 0.5 V. Then slide the 1383 forward, out of its cabinet, and set R322 (on the under side) so that the panel meter indicates exactly 1 V.

TABLE 7-2

Equipment required for recalibration.

INSTRUMENT	REQUIREMENTS	RECOMMENDED
Voltmeter	True rms, 20 MHz upper frequency limit	Ballantine Model 323
Grid Dip Meter	Must cover 60 MHz	Millen No. 90651
Multimeter	20,000 Ω/V sensitivity	Triplett Model 630A

7.4 TROUBLE ANALYSIS.

A sine-wave signal of 40 to 80 MHz from a signal generator, such as the GR 1003, may be substituted for the noise source of the 1383. Apply the signal from the generator through a 1-kΩ resistance to AT101 of the 1383 with V901 removed. Set the OUTPUT LEVEL control fully cw and the METER FULL SCALE switch to 1 V. With the 1383 functioning properly, a 300-500 μV signal will give a full-scale meter deflection over the entire 40-80 MHz range.

A 500-μV, 50-MHz signal from the generator should produce a 15 mV signal at the output of the 40-80 MHz amplifier (AT102). This input should also produce a signal of approximately 500 mV, 10 MHz at the OUTPUT terminals.

TABLE 7-3
DC Test Voltages

Conditions: Line, 115 V, ac, 60 Hz — Meter Full Scale switch, 1 V — Output Level, Full ccw

All voltages to chassis ground. Readings taken with 1806 Electronic Voltmeter or equivalent.

TEST POINT		DC VOLTS
Amplifier, 40–80 MHz		
Q101	E	+0.7
	C	–5.2
Q102	E	–5.8
	C	+0.03
Q103	E	–5.8
	C	–0.06
Q104	E	+0.7
	C	–5.2
Q105	E	–5.8
	C	0
Q106	E	–5.8
	C	–0.15
Q107	E	+0.65
	C	–5.2
Q108	E	–5.8
	C	0
Q109	E	–5.8
	C	–0.15
Local Oscillator, 60 MHz		
Q201A	E	–0.8
	C	0
Q201B	E	–0.8
	C	0
Q202	E	+0.05
	C	+9.6

TEST POINTS		DC VOLTS
Q203	E	–0.7
	C	+3.8
Q204	E	–0.7
	C	+9.6
Video Amplifier		
Q301	E	+0.75
	C	–5.2
Q302	E	–5.8
	C	–0.3
Q303	E	–5.8
	C	+0.5
Q304	E	+0.75
	C	–5.2
Q305	E	–6.0
	C	–0.5
Q306	E	–6.0
	C	–0.2
Q307	E	+0.7
	C	–5.0*
Q308	E	–5.6*
	C	–0.7*
Q309	E	–5.6*
	C	+2.0*
Q310	E	–0.8
	C	+3.0

TEST POINTS		DC VOLTS
Regulator, ±10 V		
Q501	E (AT527)	+15.0
	C	+13.5
Q502	E	+5.0
	C	+14.4
Q503	E (AT523)	+14.5
	C (AT530)	+10.0
Q504	E	0
	C	–14.0
Q505	E (AT529)	–15.0
	C	–13.5
Q506	E (AT526)	–14.0
	C (AT532)	–10.0
Filament Regulator		
Q110	E (AT109)	–60.0
	C	–62.0
Q111	E	–66.0
	C	–64.0
Q112	E	–64.0
	C	–60.0
Q901	E (AT106)	–66.0
	C (AT112)	–64.0
V901	#3 (AT112)	–64.0
	#4 (AT108)	–60.0

*Varies with setting of bias control, R327.

7.5 KNOB REMOVAL.

To remove the knob on a front-panel control, either to replace one that has been damaged or to replace the associated control, proceed as follows:

a. Grasp the knob firmly with the fingers, close into the panel (or the indicator dial, if applicable) and pull the knob straight, away from the panel.

CAUTION

Do not pull on the dial to remove a dial/knob assembly. Always remove the knob first.

b. Observe the position of the setscrew in the bushing, with respect to any panel markings (or at the full CCW position of a continuous control).

c. Release the setscrew with an Allen wrench and pull the bushing off the shaft.

d. Remove and retain the black nylon thrust washer, behind the dial/knob assembly, as appropriate.

NOTE

To separate the bushing from the knob, if for any reason they should be combined off the instrument, drive a machine-screw tap a turn or two into the bushing to provide sufficient grip for easy separation.

7.6 KNOB INSTALLATION.

To install a "Snap-on" knob assembly on the control shaft:

a. Place the black nylon thrust washer over the control shaft, if appropriate.

b. Mount the bushing on the shaft, using small slotted piece of wrapping paper as a shim for adequate clearance.

c. Orient the setscrew on the bushing with respect to the panel-marking index and lock the setscrew with an Allen wrench.

NOTE

Make sure that the end of the shaft does not protrude through the bushing or the knob won't seat properly.

d. Place the knob on the bushing with the retention spring opposite the setscrew.

e. Push the knob in until it bottoms and pull it slightly to check that the retention spring is seated in the bushing.

NOTE

If the retention spring in the knob comes loose, reinstall it in the interior notch with the small slit in the outer wall.

7.7 PILOT-LAMP REMOVAL.

To replace the pilot lamp (GE No. 328, GR P/N 5600-0300), remove the instrument from its cabinet. Insert a small screwdriver under the retaining strap at the rear of the lamp holder. Raise the end of the strap slightly and it will slide free, permitting the lamp to be withdrawn.

Parts Lists and Diagrams – Section 8

FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

Code	Manufacturer
00192	Jones Mfg. Co, Chicago, Illinois
00194	Walsco Electronics Corp, L.A., Calif.
00434	Schweber Electronics, Westburg, L.I., N.Y.
00656	Aerovox Corp, New Bedford, Mass.
01009	Alden Products Co, Brockton, Mass.
01121	Allen-Bradley, Co, Milwaukee, Wisc.
01295	Texas Instruments, Inc, Dallas, Texas
02114	Ferroxcube Corp, Saugerties, N.Y. 12477
02606	Fenwal Lab Inc, Morton Grove, Ill.
02660	Amphenol Electron Corp, Broadview, Ill.
02768	Fastex, Des Plaines, Ill. 60016
03508	G.E. Semicon Prod, Syracuse, N.Y. 13201
03636	Grayburne, Yonkers, N.Y. 10701
03888	Pyrofilm Resistor Co, Cedar Knolls, N.J.
03911	Clairex Corp, New York, N.Y. 10001
04009	Arrow-Hart & Hegeman, Hartford, Conn. 06106
04713	Motorola, Phoenix, Ariz. 85008
05170	Engr'd Electronics, Santa Ana, Calif. 92702
05624	Barber-Colman Co, Rockford, Ill. 61101
05820	Wakefield Eng, Inc, Wakefield, Mass. 01880
07126	Digitron Co, Pasadena, Calif.
07127	Eagle Signal (E.W. Bliss Co), Baraboo, Wisc.
07261	Avnet Corp, Culver City, Calif. 90230
07263	Fairchild Camera, Mountain View, Calif.
07387	Birtcher Corp, No. Los Angeles, Calif.
07595	Amer Semicond, Arlington Hts, Ill. 60004
07828	Bodine Corp, Bridgeport, Conn. 06605
07829	Bodine Electric Co, Chicago, Ill. 60618
07910	Cont Device Corp, Hawthorne, Calif.
07983	State Labs Inc, N.Y., N.Y. 10003
07999	Borg Inst., Delavan, Wisc. 53115
08730	Vemaline Prod Co, Franklin Lakes, N.J.
09213	G.E. Semiconductor, Buffalo, N.Y.
09408	Star-Tronics Inc, Georgetown, Mass. 01830
09823	Burgess Battery Co, Freeport, Ill.
09922	Burndy Corp, Norwalk, Conn. 06852
11236	C.T.S. of Berne, Inc, Berne, Ind. 46711
11599	Chandler Evans Corp, W. Hartford, Conn.
12040	National Semiconductor, Danbury, Conn.
12498	Crystalonics, Cambridge, Mass. 02140
12672	RCA, Woodbridge, N.J.
12697	Clarostat Mfg Co, Inc, Dover, N.H. 03820
12954	Dickson Electronics, Scottsdale, Ariz.
13327	Solitron Devices, Tappan, N.Y. 10983
14433	ITT Semicondictors, W.Palm Beach, Fla.
14655	Cornell-Dubilier Electric Co, Newark, N.J.
14674	Corning Glass Works, Corning, N.Y.
14936	General Instrument Corp, Hicksville, N.Y.
15238	ITT, Semiconductor Div, Lawrence, Mass.
15605	Cutlet-Hammer Inc, Milwaukee, Wisc. 53233
16037	Spruce Pine Mica Co, Spruce Pine, N.C.
17771	Singer Co, Diehl Div, Somerville, N.J.
19396	Illinois Tool Works, Pakton Div, Chicago, Ill.
19644	LRC Electronics, Horseheads, N.Y.
19701	Electra Mfg Co, Independence, Kansas 67301
21335	Fafnir Bearing Co, New Briton, Conn.
22753	UID Electronics Corp, Hollywood, Fla.
23342	Avnet Electronics Corp, Franklin Park, Ill.
24446	G.E., Schenectady, N.Y. 12305
24454	G.E., Electronics Comp, Syracuse, N.Y.
24455	G.E. (Lamp Div), Nela Park, Cleveland, Ohio
24655	General Radio Co, W. Concord, Mass. 01781
26806	American Zettlet Inc, Costa Mesa, Calif.
28520	Hayman Mfg Co, Kenilworth, N.J.
28959	Hoffman Electronics Corp, El Monte, Calif.
30874	I.B.M, Armonk, New York
32001	Jensen Mfg. Co, Chicago, Ill. 60638
33173	G.E. Comp, Owensboro, Ky. 42301
35929	Constanta Co, Mont. 19, Que.
37942	P.R. Mallory & Co Inc, Indianapolis, Ind.
38443	Marlin-Rockwell Corp, Jamestown, N.Y.
40931	Honeywell Inc, Minneapolis, Minn. 55408
42190	Muter Co, Chicago, Ill. 60638
42498	National Co, Inc, Melrose, Mass. 02176
43991	Norma-Hoffman, Stanford, Conn. 06904
49671	RCA, New York, N.Y. 10020
49956	Raytheon Mfg Co, Waltham, Mass. 02154
53021	Sangamo Electric Co, Springfield, Ill. 62705
54294	Shallcross Mfg Co, Selma, N.C.
54715	Shure Brothers, Inc, Evanston Ill.
56289	Sprague Electric Co, N. Adams, Mass.
59730	Thomas and Betts Co, Elizabeth, N.J. 07207
59875	TRW Inc, (Accessories Div), Cleveland, Ohio
60399	Torrington Mfg Co, Torrington, Conn.
61637	Union Carbide Corp, New York, N.Y. 10017
61864	United-Carr Fastener Corp, Boston, Mass.
63060	Victoreen Instrument Co, Inc, Cleveland, O.
63743	Ward Leonard Electric Co, Mt. Vernon, N.Y.
65083	Westinghouse (Lamp Div), Bloomfield, N.J.
65092	Weston Instruments, Newark, N.J.
70485	Atlantic-India Rubber, Chicago, Ill. 60607
70563	Amperite Co, Union City, N.J. 07087
70903	Belden Mfg Co, Chicago, Ill. 60644
71126	Bronson, Homer D, Co, Beacon Falls, Conn.
71294	Canfield, H.O. Co, Clifton Forge, Va. 24422
71400	Bussman (McGraw Edison), St. Louis, Mo.
71468	ITT Cannon Elec, L.A., Calif. 90031
71590	Centralab, Inc, Milwaukee, Wisc. 53212
71666	Continental Carbon Co, Inc, New York, N.Y.
71707	Coto Coil Co Inc, Providence, R.I.
71744	Chicago Miniature Lamp Works, Chicago, Ill.
71785	Cinch Mfg Co, Chicago, Ill. 60624
71823	Darnell Corp, Ltd, Downey, Calif. 90241
72136	Electro Motive Mfg Co, Wilmington, Conn.
72259	Nytronics Inc, Berkeley Heights, N.J. 07922
72619	Dialight Co, Brooklyn, N.Y. 11237
72699	General Instr Corp, Newark, N.J. 07104
72765	Drake Mfg Co, Chicago, Ill. 60656
72825	Hugh H. Eby Inc, Philadelphia, Penn. 19144
72962	Elastic Stop Nut Corp, Union, N.J. 07083
72982	Erie Technological Products Inc, Erie, Penn.
73138	Beckman Inc, Fullerton, Calif. 92634
73445	Amperex Electronics Co, Hicksville, N.Y.
73559	Carling Electric Co, W.Hartford, Conn.
73690	Elco Resistor Co, New York, N.Y.
73899	JFD Electronics Corp, Brooklyn, N.Y.
74193	Heinemann Electric Co, Trenton, N.J.
74861	Industrial Condenser Corp, Chicago, Ill.
74970	E.F. Johnson Co, Waseca, Minn. 56093
75042	IRC Inc, Philadelphia, Penn. 19108
75382	Kulka Electric Corp, Mt. Vernon, N.Y.
75491	Lafayette Industrial Electronics, Jamica, N.Y.
75608	Linden and Co, Providence, R.I.
75915	Littelfuse, Inc, Des Plaines, Ill. 60016
76005	Lord Mfg Co, Erie, Penn. 16512
76149	Mallory Electric Corp, Detroit, Mich. 48204
76487	James Millen Mfg Co, Malden, Mass. 02148
76545	Mueller Electric Co, Cleveland, Ohio 44114
76684	National Tube Co, Pittsburg, Penn.
76854	Oak Mfg Co, Crystal Lake, Ill.
77147	Patton MacGuyer Co, Providence, R.I.
77166	Pass-Seymour, Syracuse, N.Y.
77263	Pierce Roberts Rubber Co, Trenton, N.J.
77339	Positive Lockwasher Co, Newark, N.J.
77542	Ray-O-Vac Co, Madison, Wisc.
77630	TRW, Electronic Comp, Camden, N.J. 08103
77638	General Instruments Corp, Brooklyn, N.Y.
78189	Shakeproof (Ill. Tool Works), Elgin, Ill. 60120
78277	Sigma Instruments Inc, S.Braintree, Mass.
78488	Stackpole Carbon Co, St. Marys, Penn.
78553	Tinnerman Products, Inc, Cleveland, Ohio
79089	RCA, Rec Tube & Semicond, Harrison, N.J.
79725	Wiremold Co, Hartford, Conn. 06110
79963	Zierick Mfg Co, New Rochelle, N.Y.
80030	Prestole Fastener, Toledo, Ohio
80048	Vickers Inc, St. Louis, Mo.
80131	Electronic Industries Assoc, Washington, D.C.
80183	Sprague Products Co, No. Adams, Mass.
80211	Motorola Inc, Franklin Park, Ill. 60131
80258	Standard Oil Co, Lafeyette, Ind.
80294	Bourns Inc, Riverside, Calif. 92506
80431	Air Filter Corp, Milwaukee, Wisc. 53218
80583	Hammarlund Co, Inc, New York, N.Y.
80740	Beckman Instruments, Inc, Fullerton, Calif.
81030	International Insturment, Orange, Conn.
81073	Grayhill Inc, LaGrange, Ill. 60525
81143	Isolantite Mfg Corp, Stirling, N.J. 07980
81349	Military Specifications
81350	Joint Army-Navy Specifications
81751	Columbus Electronics Corp, Yonkers, N.Y.
81831	Filtron Co, Flushing, L.I., N.Y. 11354
81840	Ledex Inc, Dayton, Ohio 45402
81860	Barry-Wright Corp, Watertown, Mass.
82219	Sylvania Elec Prod, Emporium, Penn.
82273	Indiana Pattern & Model Works, LaPort, Ind.
82389	Switchcraft Inc, Chicago, Ill. 60630
82647	Metals & Controls Inc, Attleboro, Mass.
82807	Milwaukee Resistor Co, Milwaukee, Wisc.
83033	Meissner Mfg, (Maguire Ind) Mt. Carmel, Ill.
83058	Carr Fastener Co, Cambridge, Mass.
83186	Victory Engineering, Springfield, N.J. 07081
83361	Bearing Specialty Co, San Francisco, Calif.
83587	Solar Electric Corp, Warren, Penn.
83740	Union Carbide Corp, New York, N.Y. 10017
83781	National Electronics Inc, Geneva, Ill.
84411	TRW Capacitor Div, Ogallala, Nebr.
84835	Lehigh Metal Prods, Cambridge, Mass. 02140
84971	TA Mfg Corp, Los Angeles, Calif.
86577	Precision Metal Prods, Stoneham, Mass. 02180
86684	RCA (Elect. Comp & Dev), Harrison, N.J.
86687	REC Corp, New Rochelle, N.Y. 10801
86800	Cont Electronics Corp, Brooklyn, N.Y. 11222
88140	Cutler-Hammer Inc, Lincoln, Ill.
88219	Gould Nat. Batteries Inc, Trenton, N.J.
88419	Cornell-Dubilier, Fuquay-Varina, N.C.
88627	K & G Mfg Co, New York, N.Y.
89482	Holtzer-Cabot Corp, Boston, Mass.
89665	United Transformer Co, Chicago, Ill.
90201	Mallory Capacitor Co, Indianapolis, Ind.
90750	Westinghouse Electric Corp, Boston, Mass.
90952	Hardware Products Co, Reading, Penn. 19602
91032	Continental Wire Corp, York, Penn. 17405
91146	ITT (Cannon Electric Inc), Salem, Mass.
91293	Johanson Mfg Co, Boonton, N.J. 07005
91506	Augat Inc, Attleboro, Mass. 02703
91598	Chandler Co, Wethersfield, Conn. 06109
91637	Dale Electronics Inc, Columbus, Nebr.
91662	Elco Corp, Willow Grove, Penn.
91719	General Instruments, Inc, Dallas, Texas
91929	Honeywell Inc, Freeport, Ill.
92519	Electra Insul Corp, Woodside, L.I., N.Y.
92678	E.G.&G., Boston, Mass.
93332	Sylvania Elect Prods, Inc, Woburn, Mass.
93916	Cramer Products Co, New York, N.Y. 10013
94144	Raytheon Co, Components Div, Quincy, Mass.
94154	Tung Sol Electric Inc, Newark, N.J.
95076	Garde Mfg Co, Cumberland, R.I.
95121	Quality Components Inc, St. Mary's, Penn.
95146	Alco Electronics Mfg Co, Lawrence, Mass.
95238	Continental Connector Corp, Woodside, N.Y.
95275	Vitramon, Inc, Bridgeport, Conn.
95354	Methode Mfg Co, Chicago, Ill.
95412	General Electric Co, Schenectady, N.Y.
95794	Anaconda Amer Brass Co, Torrington, Conn.
96095	Hi-Q Div. of Aerovox Corp, Orlean, N.Y.
96214	Texas Instruments Inc, Dallas, Texas 75209
96256	Thordarson-Meissner, Mt. Carmel, Ill.
96341	Microwave Associates Inc, Burlington, Mass.
96791	Amphenol Corp, Jonesville, Wisc, 53545
96906	Military Standards
98291	Sealectro Corp, Mamaroneck, N.Y. 10544
98474	Compar Inc, Burlingame, Calif.
98821	North Hills Electronics Inc, Glen Cove, N.Y.
99180	Transitron Electronics Corp, Melrose, Mass.
99313	Varian, Palo Alto, Calif. 94303
99378	Atlee Corp, Winchester, Mass. 01890
99800	Delevan Electronics Corp, E. Aurora, N.Y.

MECHANICAL PARTS LIST

Name	*Description*	*GR Part Number*	*FMC*	*Mfg. Part Number*	*Federal Stock No.*
Cabinet	Complete, Convertible-Bench	4181-2646	24655	4181-2646	
Meter Cover	ME3-701, light gray	5720-3713	24655	5720-3713	
Knob Asm.	OUTPUT LEVEL Knob, including retainer 5220-5402	5520-5321	24655	5520-5321	
Dial Asm.	METER FULL SCALE dial, including retainer 4123-3241	1383-1110	24655	1383-1110	
Knob Asm.	METER FULL SCALE Knob, including retainer 5220-5402	5500-5321	24655	5500-5321	
Cover Plate	OUTPUT Cover Plate, Complete	0480-2470	24655	0480-2470	
Dress Nut	For Power Toggle Switch, 15/32—32, Dress	5800-0800	24655	5800-0800	5310-344-3634
Foot	Rear, black Neoprene Foot	5260-2060	24655	5260-2060	
Foot	Right, front black Phenolic Foot for use with Bail	5250-2121	24655	5250-2121	
	Left, front black Phenolic Foot, for use with Bail	5250-2120	24655	5250-2120	
Bail	Tilt-bar support	5250-2125	24655	5250-2125	
Fuseholder	Extraction-post Fuse-mounting Device	5650-0100	71400	HKP-H	5920-284-7144
	Output Connector Assembly	0874-4624	24655	0874-4624	
	Panel Jack	0874-6690	24655	0874-6690	

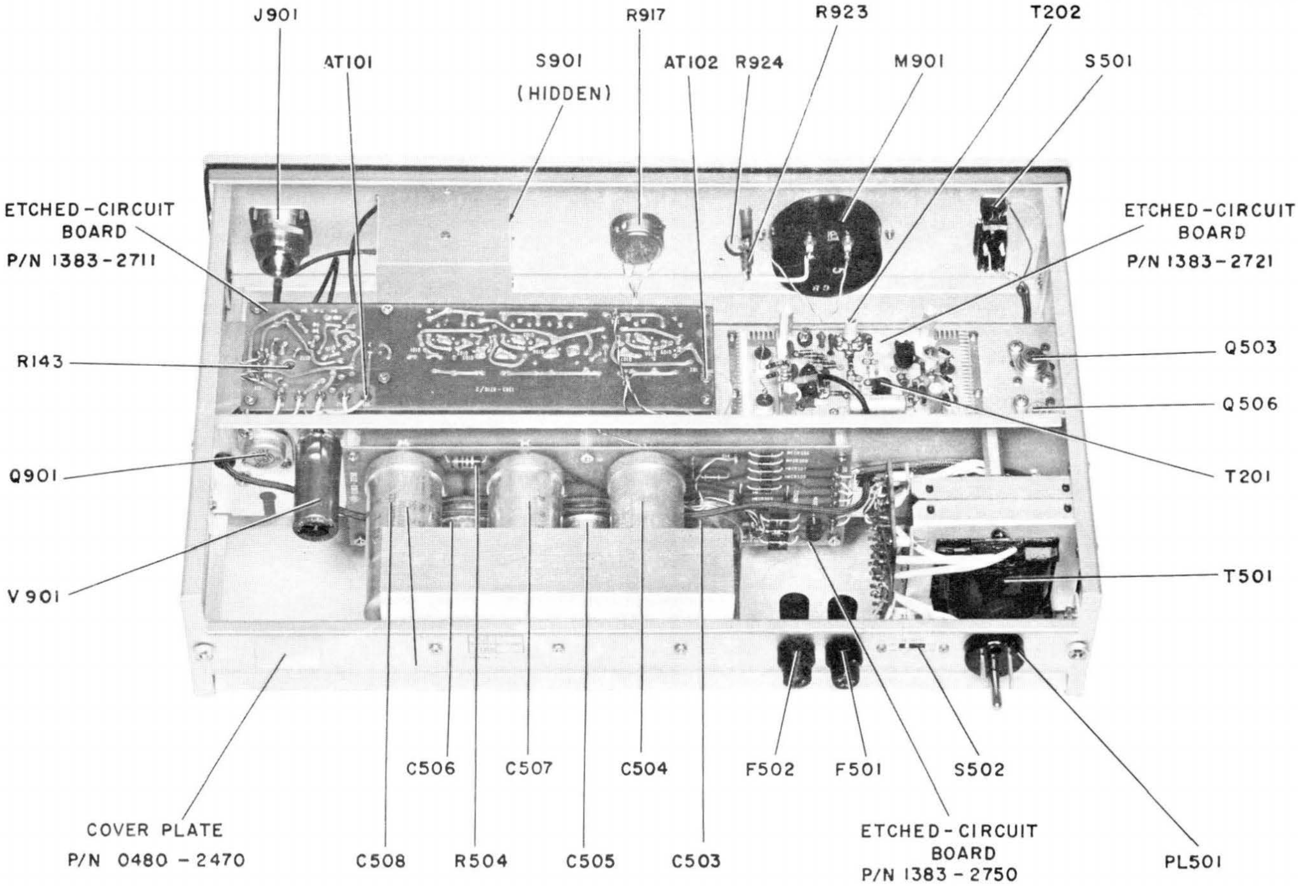


Figure 8-1. Top interior view of the Generator.

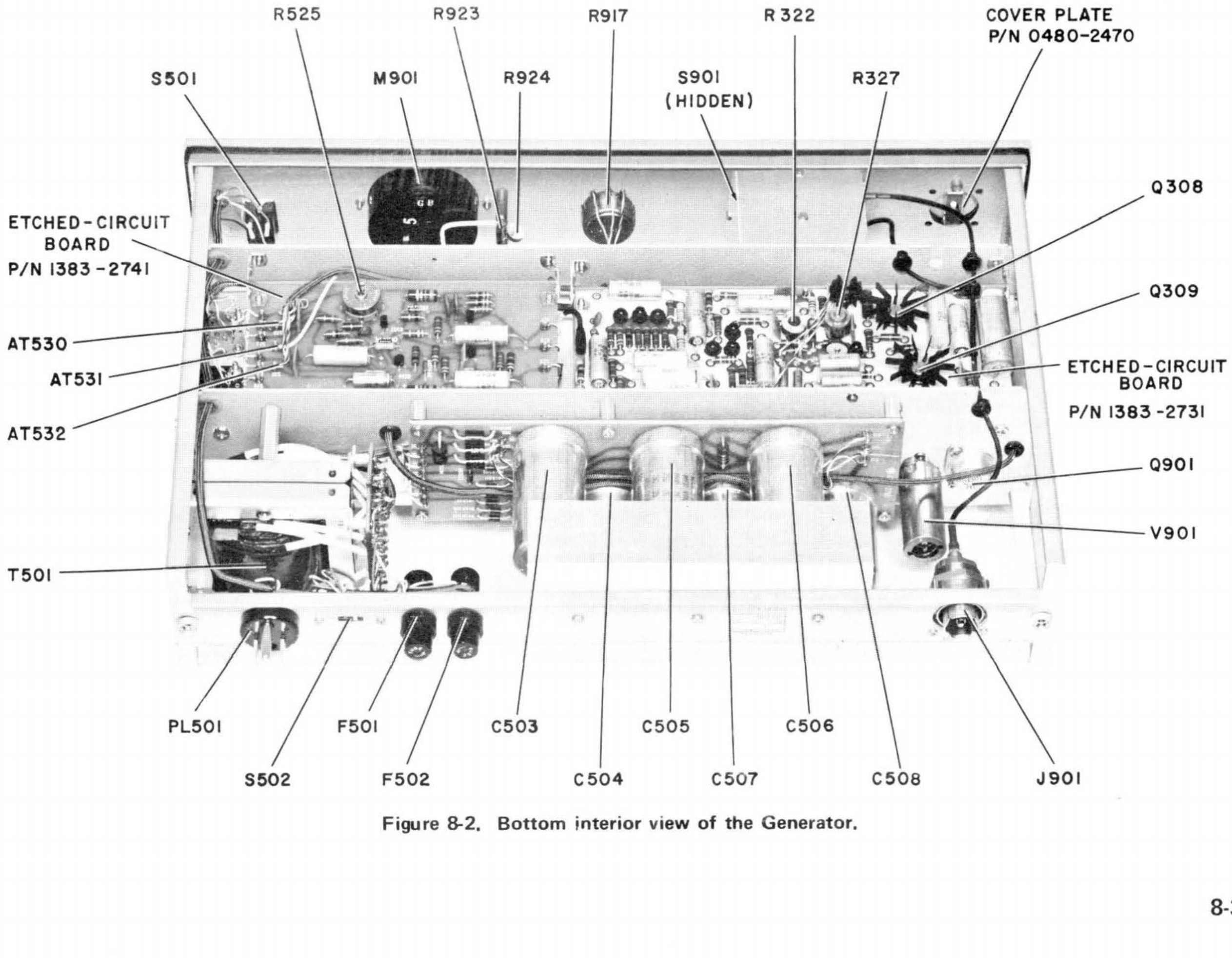


Figure 8-2. Bottom interior view of the Generator.

Ref. No.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
CAPACITORS					
C101	Ceramic, 0.01 μF +80-20% 500 V	4406-3109	72982	811, 0.01 μF +80-20%	5910-754-7049
C102	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C103	Ceramic, 0.1 μF ±20% 25 V	4400-2050	80183	5C13, 0.1 μF	5910-974-5695
C104	Ceramic, 33 pF ±5% 500 V	4404-0335	72982	831, 33 pF ±5%	
C105	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C106	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C107	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C108	Ceramic, 33 pF ±5% 500 V	4404-0335	72982	831, 33 pF ±5%	
C109	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C110	Ceramic, 51 pF ±5% 500 V	4404-0515	72982	831, 51 pF ±5%	
C111	Ceramic, 56 pF ±5% 500 V	4404-0565	72982	831, 56 pF ±5%	
C112	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, .001 μF +80-20%	5910-983-9994
C113	Ceramic, 33 pF ±5% 500 V	4404-0335	72982	831, 33 pF ±5%	
C114	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C116	Ceramic, 0.1 μF ±20% 25 V	4400-2050	80183	SC13, 0.1 μF	5910-974-5695
C117	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C118	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C119	Ceramic, 0.1 μF +80-20% 10 V	4431-4109	80183	20C202, 0.1 μF +80-20%	
C120	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C121	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C122	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C123	Ceramic, 0.1 μF ±20% 25 V	4400-2050	80183	5C13, 0.1 μF	5910-974-5695
C124	Ceramic, 0.01 μF +80-20% 500 V	4406-3109	72982	811, 0.01 μF +80-20%	5910-754-7049
C125	Ceramic, 0.01 μF +80-20% 500 V	4406-3109	72982	811, 0.01 μF +80-20%	5910-754-7049
C126	Ceramic, 0.01 μF +80-20% 500 V	4406-3109	72982	811, 0.01 μF +80- 20%	5910-754-7049
DIODES					
CR101	Type IN750A	6083-1028	07910	IN750A	5960-754-5897
CR102	Type IN748A	6083-1002	07910	IN748A	5960-800-3973
CR103	Type IN4009	6082-1012	24446	IN4009	5961-892-8700
CR104	Type IN4009	6082-1012	24446	IN4009	5961-892-8700
CR105	Type IN4009	6082-1012	24446	IN4009	5961-892-8700
CR201	Type MS7330	6082-1027	13327	MS7330	
CR202	Type MS7330	6082-1027	13327	MS7330	
RESISTORS					
R101	Composition, 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R102	Composition, 560 Ω ±5% 1/4 W	6099-1565	75042	BTS, 560 Ω ±5%	
R103	Composition, 90.9 Ω ±1% 1/8 W	6250-9909	75042	CEA, 90.9 Ω ±1%	
R104	Composition, 10 Ω ±1% 1/8 W	6250-0010	75042	CEA, 10 Ω ±1%	
R105	Composition, 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R106	Composition, 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R107	Composition, 910 Ω ±5% 1/4 W	6099-1915	75042	BTS, 910 Ω ±5%	
R110	Composition, 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R111	Composition, 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R112	Composition, 560 Ω ±5% 1/4 W	6099-1565	75042	BTS, 560 Ω ±5%	
R113	Composition, 90.9 Ω ±1% 1/8 W	6250-9909	75042	CEA, 90.9 Ω ±1%	
R114	Composition, 10 Ω ±1% 1/8 W	6250-0010	75042	CEA, 10 Ω ±1%	
R115	Composition, 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R116	Composition, 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R117	Composition, 910 Ω ±5% 1/4 W	6099-1915	75042	BTS, 910 Ω ±5%	
R120	Composition, 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R121	Composition, 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R122	Composition, 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R123	Composition, 560 Ω ±5% 1/4 W	6099-1565	75042	BTS, 560 Ω ±5%	
R124	Composition, 90.9 Ω ±1% 1/8 W	6250-9909	75042	CEA, 90.9 Ω ±1%	
R125	Composition, 10 Ω ±1% 1/8 W	6250-0010	75042	CEA, 10 Ω ±1%	
R126	Composition, 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R127	Composition, 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R128	Composition, 910 Ω ±5% 1/4 W	6099-1915	75042	BTS, 910 Ω ±5%	
R131	Composition, 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R132	Composition, 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R133	Composition, 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R134	Composition, 5.1 kΩ ±5% 1/4 W	6099-2515	75042	BTS, 5.1 kΩ ±5%	
R135	Composition, 680 Ω ±5% 1/2 W	6100-1685	01121	RC20GF681J	5905-195-6791
R136	Composition, 100 Ω ±5% 1/2 W	6100-1105	01121	RC20GF101J	5905-190-8889
R137	Composition, 100 Ω ±5% 1/2 W	6100-1105	01121	RC20GF101J	5905-190-8889
R138	Composition, 510 Ω ±5% 1/2 W	6100-1515	01121	RC20GF511J	5905-279-3511
R139	Composition, 680 Ω ±5% 1/2 W	6100-1685	01121	RC20GF681J	5905-195-6791
R140	Composition, 62 Ω ±5% 1/2 W	6100-0625	01121	RC20GF620J	5905-279-1760
R141	Composition, 150 Ω ±5% 1/2 W	6100-1155	01121	RC20GF151J	5905-299-1541
R143	Pot., Wire Wound 300 Ω ±10%	6056-0135	11236	115, 300 Ω ±10%	
R144	Composition, 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R145	Composition, 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596

PARTS LIST (Cont)

Ref. No.	*Description*	*Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
TRANSISTORS					
Q101	Type 2N3250	8210-1089	80211	2N3250	5961-945-4108
Q102	Type 2N2857	8210-1088	24454	2N2810-A	
Q103	Type 2N3646	8210-1119	07263	2N3646	5961-964-5753
Q104	Type 2N3640	8210-1129	93916	2N3640	
Q105	Type 2N2857	8210-1088	24454	2N2810-A	
Q106	Type 2N3646	8210-1119	07263	2N3646	5961-964-5753
Q107	Type 2N3640	8210-1129	93916	2N3640	
Q108	Type 2N2857	8210-1088	24454	2N2810-A	
Q109	Type 2N3646	8210-1119	07263	2N3646	
Q110	Type 2N3905	8210-1114	04713	2N3905	
Q111	Type 2N3414	8210-1047	24446	2N3416	5961-989-2749
Q112	Type 2N3414	8210-1047	24446	2N3416	5961-989-2749
Q901	Type 2N3055	8210-1097	12672	40251	
MISCELLANEOUS					
L101	Choke, Molded, 0.15 μH ±10%	4300-0101	99800	1536, 0.15 μH ±10%	
L102	Choke, Molded, 0.15 μH ±10%	4300-0101	99800	1536, 0.15 μH ±10%	
T101	Coil	5000-2711	24655	5000-2711	
V901	Type 5722	8380-5722	82219	5722	

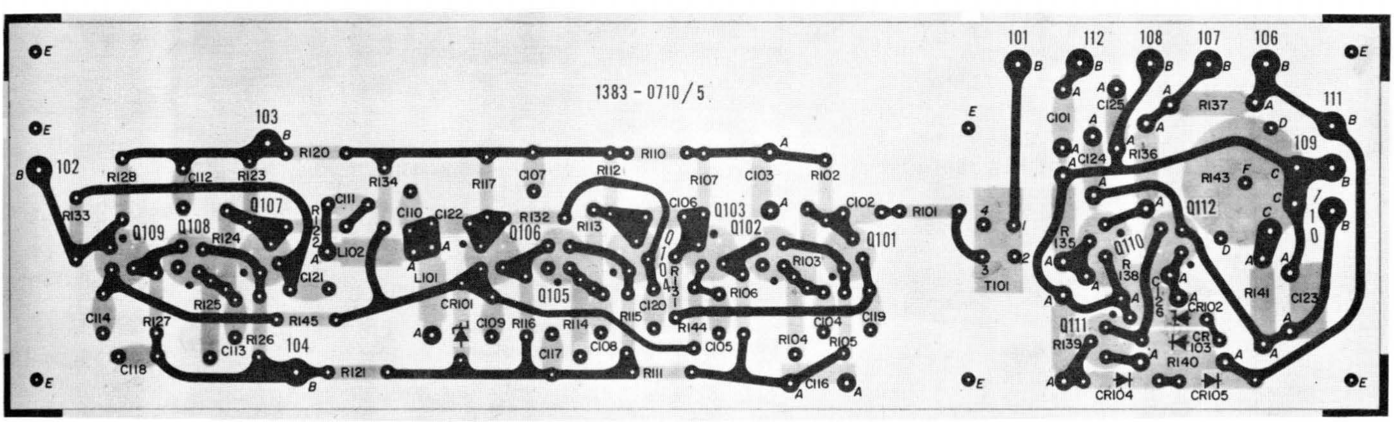
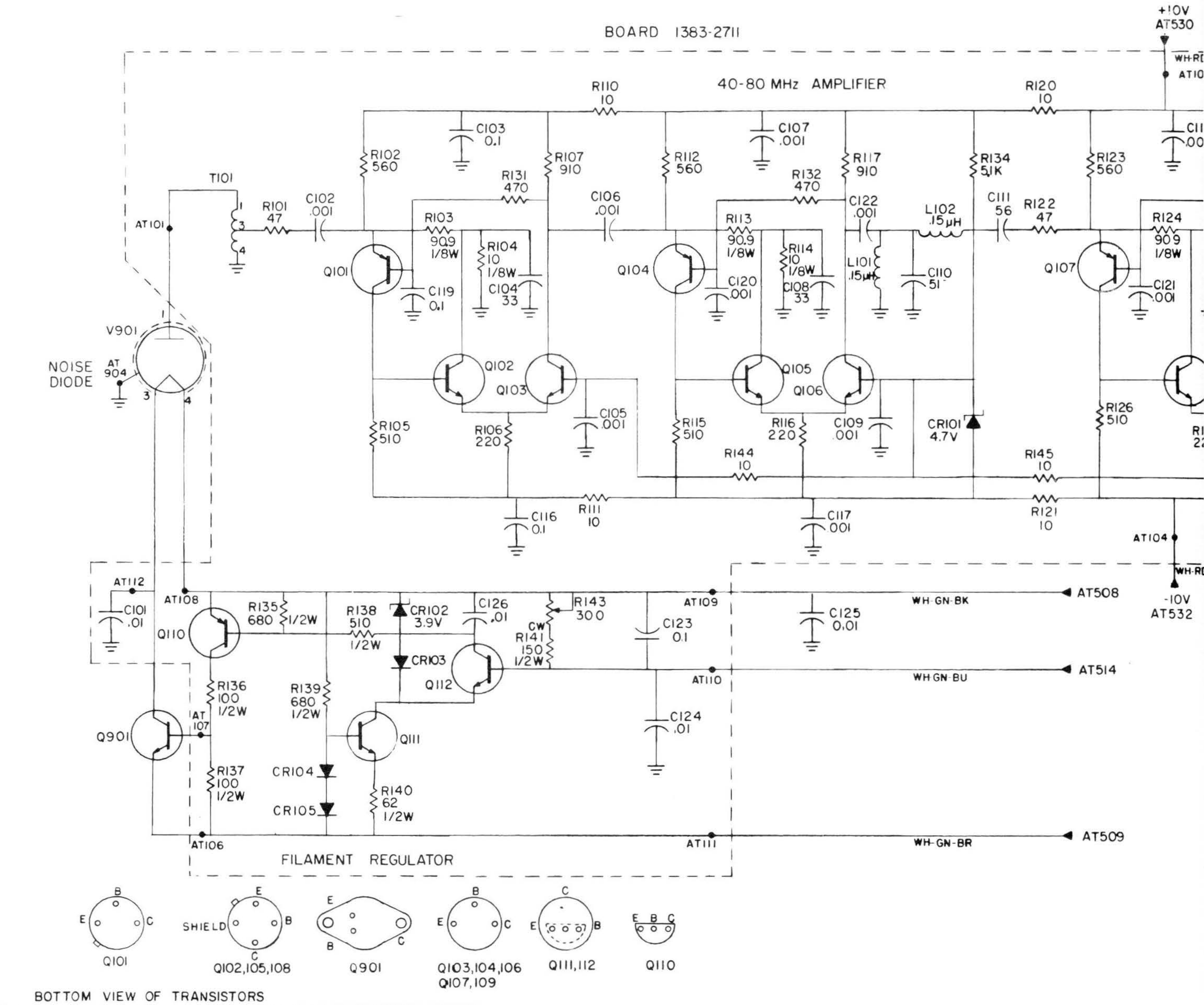


Figure 8-3. Etched-circuit-board assembly for the 40-80-MHz amplifier. The complete board is P/N 1383-2711.

NOTE: The number appearing on the foil side is not the part number. The dot on the foil at the transistor socket indicates the collector lead.



NOTE UNLESS SPECIFIED	
1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE.	5. RESISTANCE IN OHMS K = 1000 OHMS M = 1 MEGOHM
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK.	6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS, LESS THAN ONE IN MICROFARADS.
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM.	7. ◯ KNOB CONTROL
4. RESISTORS 1/4 WATT.	8. ⊘ SCREWDRIVER CONTROL
	9. AT = ANCHOR TERMINAL
	10. TP = TEST POINT

Figure 8-4. Sche
MHz amplifier.

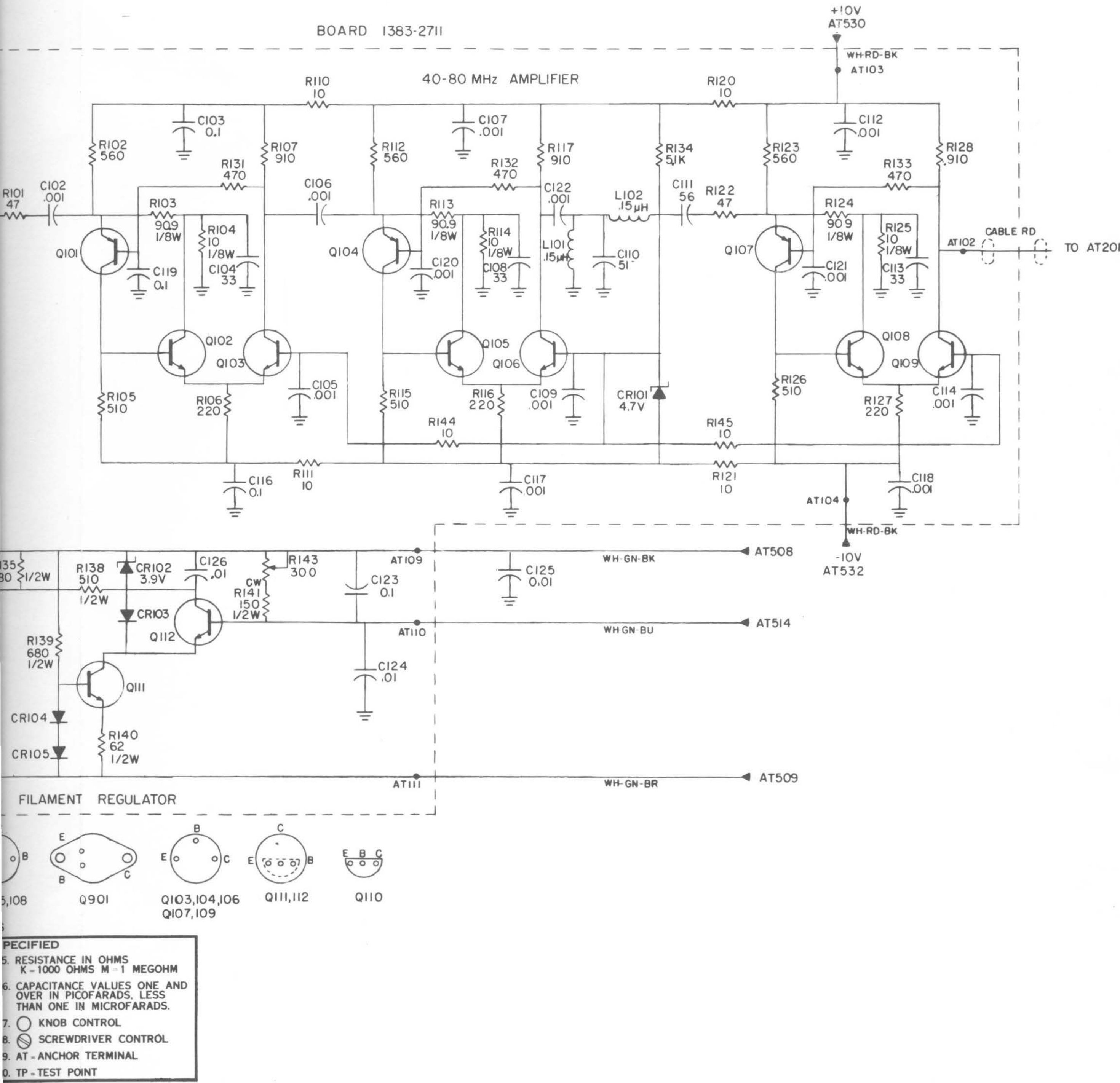


Figure 8-4. Schematic circuit diagram of the 40-80-MHz amplifier.

PARTS LIST

Ref. No.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
CAPACITORS					
C201	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C202	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C203	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C204	Ceramic, 24 pF ±5% 500 V	4410-0245	72982	811, 24 pF ±5%	
C205	Ceramic, 220 pF ±5% 500 V	4404-1225	72982	831, 220 pF ±5%	
C206	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C207	Ceramic, 10 pF ±10% 500 V	4404-0108	72982	831, 10 pF ±5%	
C208	Ceramic, 0.001 μF +80-20% 500 V	4404-2109	72982	831, 0.001 μF +80-20%	5910-983-9994
C210	Electrolytic, 100 μF +150-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C801	Mica, 170 pF ±1% 500 V	4710-0170	72915	DM15 (4CR), 170 pF ±1%	
C802	Mica, 255 pF ±1% 500 V	4710-0434	72915	DM15 (4CR), 255 pF ±1%	
C803	Mica, 232 pF ±1% 500 V	4710-0411	72915	DM15 (4CR), 232 pF ±1%	
C902	Filter, 2500 pF	5280-0100	01121	F1B, 2500, pF	5915-908-1892
C903	Filter, 2500 pF	5280-0100	01121	F1B, 2500 pF	5915-908-1892
C904	Filter, 2500 pF	5280-0100	01121	F1B, 2500 pF	5915-908-1892
C905	Filter, 2500 pF	5280-0100	01121	F1B, 2500 pF	5915-908-1892
RESISTORS					
R201	Composition, 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R202	Composition, 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R203	Composition, 1.5 kΩ ±5% 1/4 W	6099-2155	75042	BTS, 1.5 kΩ ±5%	
R204	Composition, 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R205	Composition, 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9998
R206	Composition, 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R207	Composition, 20 Ω ±5% 1/4 W	6099-0205	75042	BTS, 20 Ω ±5%	
R208	Composition, 24 Ω ±5% 1/4 W	6099-0245	75042	BTS, 24 Ω ±5%	
R209	Composition, 24 Ω ±5% 1/4 W	6099-0245	75042	BTS, 24 Ω ±5%	
R210	Composition, 20 Ω ±5% 1/4 W	6099-0205	75042	BTS, 20 Ω ±5%	
R211	Composition, 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R212	Composition, 3 kΩ ±5% 1/4 W	6099-2305	75042	BTS, 3 kΩ ±5%	5905-682-4097
R213	Composition, 910 Ω ±5% 1/4 W	6099-1915	75042	BTS, 910 Ω ±5%	
R214	Composition, 910 Ω ±5% 1/4 W	6099-1915	75042	BTS, 910 Ω ±5%	
R215	Composition, 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R917	Pot., Comp., 1 kΩ ±10%	6000-0300	01121	JU, 1 kΩ ±10%	5905-644-6789
R918	Power, Wire Wound, 0.7 Ω ±10%	6670-8709	75042	AS-10, 0.7 Ω ±10%	
R919	Composition, 30 Ω ±5% 1/4 W	6099-0305	75042	BTS, 30 Ω ±5%	
R920	Composition, 30 Ω ±5% 1/4 W	6099-0305	75042	BTS, 30 Ω ±5%	
R921	Composition, 30 Ω ±5% 1/4 W	6099-0305	75042	BTS, 30 Ω ±5%	
R922	Composition, 30 Ω ±5% 1/4 W	6099-0305	75042	BTS, 30 Ω ±5%	
MISCELLANEOUS					
CR203	Type MS7330	6082-1027	13327	MS7330	
CR204	Type MS7330	6082-1027	13327	MS7330	
L801	Choke, Molded, 0.82 ±10%	4300-7524	99800	1025-18, 0.82 ±10%	
L802	Choke, Molded, 0.82 ±10%	4300-7524	99800	1025-18, 0.82 ±10%	
L803	Choke, Molded, 0.39 ±10%	4300-7523	99800	1025-10, 0.39 ±10%	
Q201	Type TD-100	8210-1130	56289	TD-100	
Q202	Type 2N2369	8210-1052	93916	2N2369	5960-682-7755
Q203	Type 2N3646	8210-1119	07263	2N3646	
Q204	Type 2N3646	8210-1119	07263	2N3646	
T201	Coil	5000-2710	24655	5000-2710	
T202	Transformer Ass.	1383-2200	24655	1383-2200	

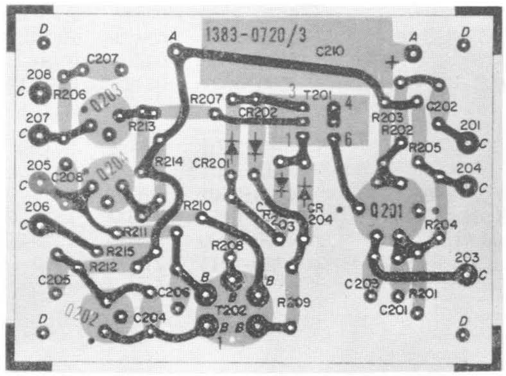


Figure 8-5. Etched-circuit-board assembly for the oscillator and modulator. The complete board is P/N 1383-2721.

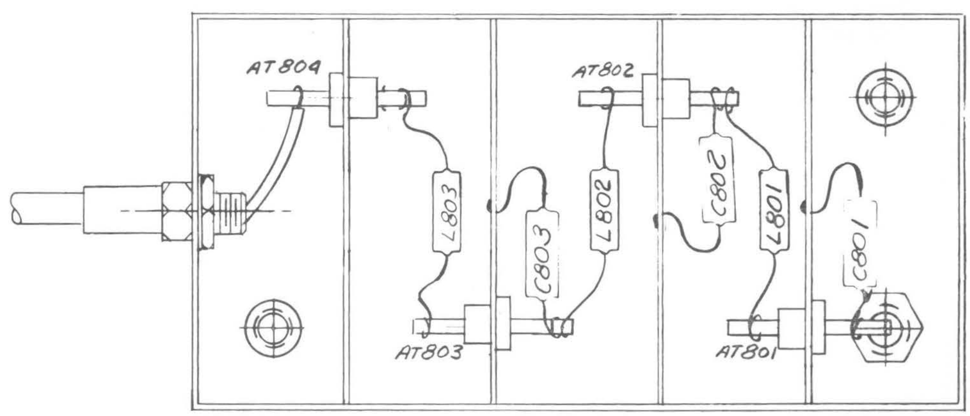
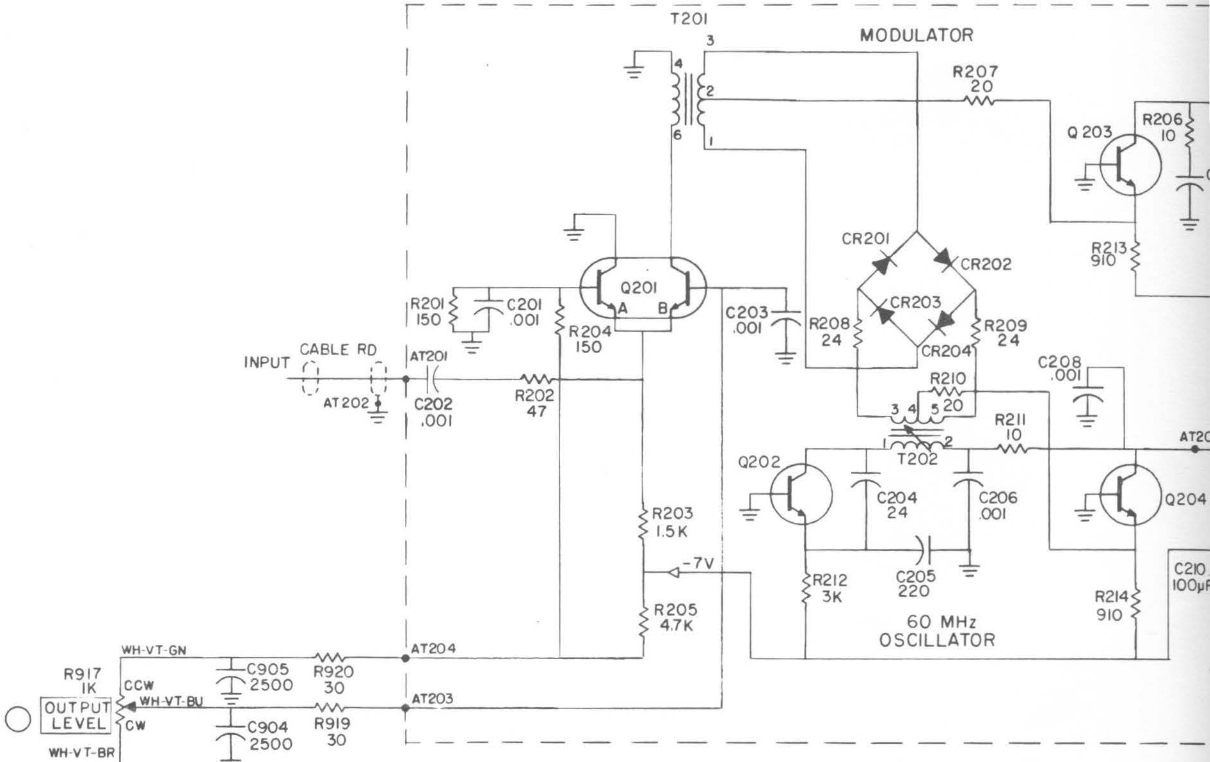


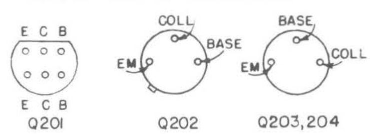
Figure 8-6. The 20-MHz low-pass filter is hidden by the regulator circuit etched board, P/N 1383-2741 (refer to paragraph 4-1).

NOTE: The number appearing on the foil side is not the part number. The dot on the foil at the transistor socket indicates the collector lead.



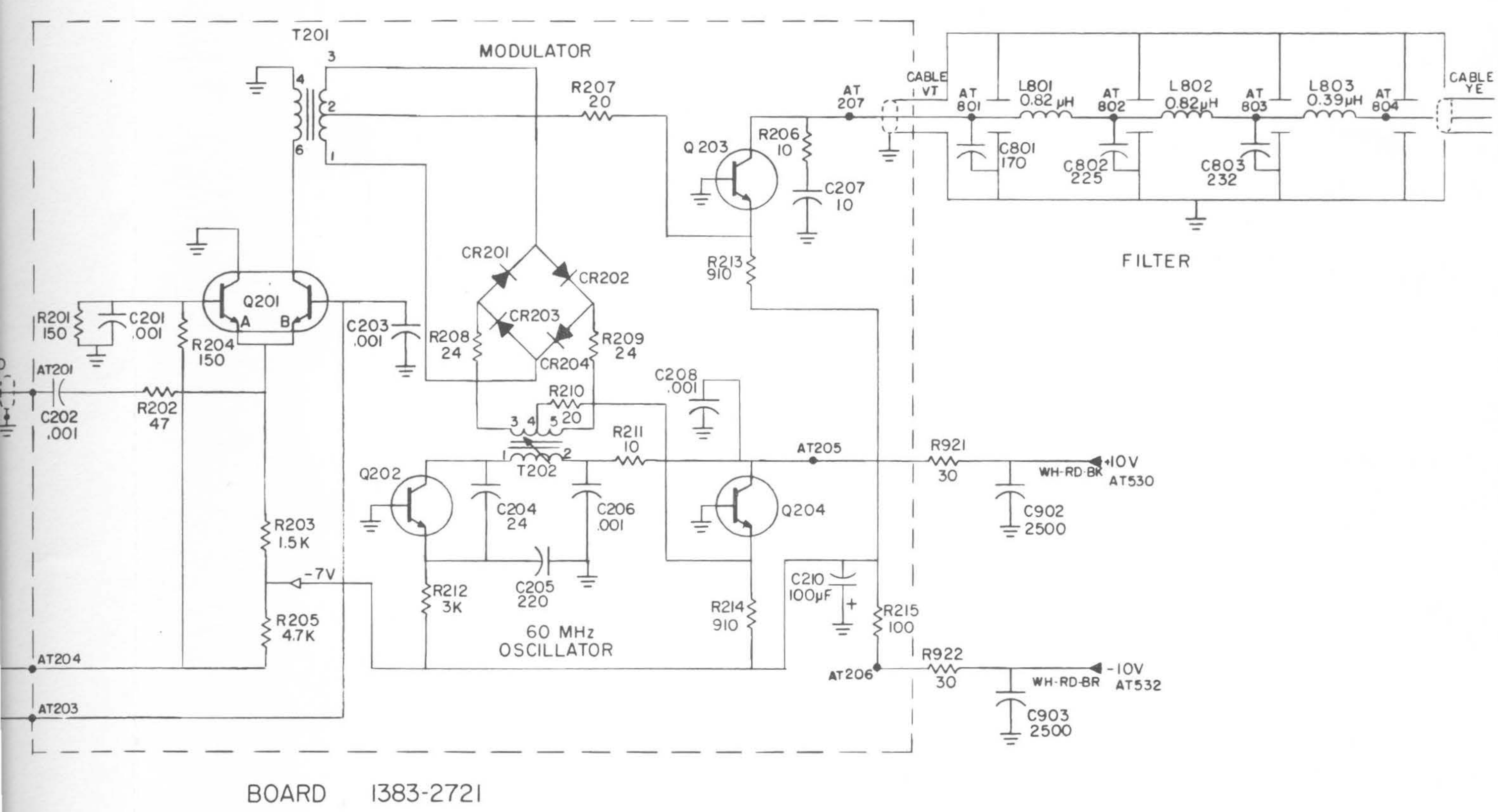
BOARD 1383-2721

BOTTOM VIEW OF TRANSISTORS



NOTE UNLESS SPECIFIED

1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE.
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK.
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM.
4. RESISTORS 1/2 WATT.
5. RESISTANCE IN OHMS K = 1000 OHMS M = 1 MEGOHM
6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS, LESS THAN ONE IN MICROFARADS.
7. ◯ = KNOB CONTROL
8. ⦸ = SCREWDRIVER CONTROL
9. AT = ANCHOR TERMINAL
10. TP = TEST POINT



NSISTORS

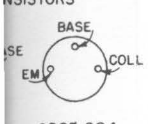


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Figure 8-7. Schematic circuit diagram of the oscillator, modulator, and 20-MHz low-pass filter.

PARTS LIST

Ref. No.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
CAPACITORS					
C301	Electrolytic, 200 μF +150-10% 6 V	4450-2610	37942	TT, 200 μF 6V	5910-945-1836
C302	Electrolytic, 100 μF +150-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C303	Electrolytic, 200 μF +150-10% 6 V	4450-2610	37942	TT, 200 μF 6 V	5910-945-1836
C304	Electrolytic, 100 μF +150-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C305	Ceramic, 51 μF ±5% 500 V	4404-0515	72982	831, 51 pF ±5%	
C306	Ceramic, 51 μF ±5% 500 V	4404-0515	72982	831, 51 pF ±5%	
C307	Electrolytic, 200 μF +150-10% 6 V	4450-2610	37942	TT, 200 μF 6 V	5910-945-1836
C308	Electrolytic, 330 μF ±20% 6 V	4450-5707	37942	TT, 300 μF 6 V	
C309	Electrolytic, 330 μF ±20% 6 V	4450-5707	37942	TT, 300 μF 6 V	
C310	Electrolytic, 200 μF +150-10% 6 V	4450-2610	37942	TT, 200 μF 6 V	5910-945-1836
C311	Electrolytic, 200 μF +150-10% 6 V	4450-2610	37942	TT, 200 μF 6 V	5910-945-1836
C312	Ceramic, 0.47 μF ±20% 25 V	4400-2054	80183	5C13, 0.47 μF ±20%	5910-974-5696
C313	Ceramic, 0.47 μF ±20% 25 V	4400-2054	80183	5C13, 0.47 μF ±20%	5910-974-5696
C314	Electrolytic, 200 μF +150-10% 6 V	4450-2610	37942	TT, 200 μF 6 V	5910-945-1836
C315	Electrolytic, 600 μF +150-10% 3 V	4450-5589	37942	TCM, 600 μF 3 V	5910-729-9975
C316	Electrolytic, 22 μF ±20% 15 V	4450-5300	56289	150D226X0015B2	5910-752-4270
C317	Electrolytic, 22 μF ±20% 15 V	4450-5300	56289	150D226X0015B2	5910-752-4270
C318	Electrolytic, 100 μF +150-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C319	Ceramic, 0.1 μF ±20% 25 V	4400-2050	80183	5C13, 0.1 μF	5910-974-5695
C320	Ceramic, 0.1 μF ±20% 25 V	4400-2050	80183	5C13, 0.1 μF	5910-974-5695
C321	Ceramic, 0.1 μF ±20% 25 V	4400-2050	80183	5C13, 0.1 μF	5910-974-5695
C322	Ceramic, 0.1 μF ±20% 25 V	4400-2050	80183	5C13, 0.1 μF	5910-974-5695
C323	Ceramic, 62 pF ±10% 500 V	4404-0628	72982	831, 62 pF ±10%	
C324	Ceramic, 27 pF ±5% 500 V	4404-0275	72982	831, 27 pF ±5%	
TRANSISTORS					
Q301	Type 2N3640	8210-1129	93916	2N3640	
Q302	Type 2N3646	8210-1119	07263	2N3646	
Q303	Type 2N3646	8210-1119	07263	2N3646	
Q304	Type 2N3640	8210-1129	93916	2N3640	
Q305	Type 2N3646	8210-1119	07263	2N3646	
Q306	Type 2N3646	8210-1119	07263	2N3646	
Q307	Type 2N3250	8210-1089	80211	2N3250	5961-945-4108
Q308	Type A211	8210-1168	73445	A211	
Q309	Type A211	8210-1168	73445	A211	
Q310	Type 2N3563	8210-1066	07263	2N3563	
RESISTORS					
R301	Composition, 470 Ω ±5% 1/2 W	6100-1475	01121	RC20GF471J	5905-192-3973
R302	Composition, 620 Ω ±5% 1/2 W	6100-1625	01121	RC20GF621J	5905-279-1761
R303	Composition, 330 Ω ±5% 1/2 W	6100-1335	01121	RC20GF331J	5905-192-3971
R304	Composition, 51 Ω ±5% 1/2 W	6100-0515	01121	RC20GF510J	5905-279-3517
R305	Composition, 510 Ω ±5% 1/2 W	6100-1515	01121	RC20GF511J	5905-279-3511
R306	Composition, 220 Ω ±5% 1/2 W	6100-1225	01121	RC20GF221J	5905-279-3513
R307	Composition, 910 Ω ±5% 1/2 W	6100-1915	01121	RC20GF911J	5905-279-3509
R308	Composition, 5.1 kΩ ±5% 1/2 W	6100-2515	01121	RC20GF512J	5905-279-2019
R309	Composition, 5.1 kΩ ±5% 1/2 W	6100-2515	01121	RC20GF512J	5905-279-2019
R310	Composition, 130 Ω ±5% 1/2 W	6100-1135	01121	RC20GF131J	5905-252-5436
R312	Composition, 47 Ω ±5% 1/2 W	6100-0475	01121	RC20GF470J	5905-252-4018
R313	Composition, 680 Ω ±5% 1/2 W	6100-1685	01121	RC20GF681J	5905-195-6791
R314	Composition, 330 Ω ±5% 1/2 W	6100-1335	01121	RC20GF331J	5905-192-3971
R315	Composition, 51 Ω ±5% 1/2 W	6100-0515	01121	RC20GF510J	5905-279-3517
R316	Composition, 510 Ω ±5% 1/2 W	6100-1515	01121	RC20GF511J	5905-279-3511
R317	Composition, 110 Ω ±5% 1/2 W	6100-1115	01121	RC20GF111J	5905-279-3515
R318	Composition, 470 Ω ±5% 1/2 W	6100-1475	01121	RC20GF471J	5905-192-3973
R319	Composition, 2.4 kΩ ±5% 1/2 W	6100-2245	01121	RC20GF242J	5905-279-1877
R320	Composition, 2.4 kΩ ±5% 1/2 W	6100-2245	01121	RC20GF242J	5905-279-1877
R321	Composition, 47 Ω ±5% 1/2 W	6100-0475	01121	RC20GF470J	5905-252-4018
R322	Pot., Comp., 50 Ω ±20%	6040-0050	01121	FWC, 50 Ω ±20%	
R323	Pot., Comp., 200 Ω ±5% 1 W	6110-1205	01121	RC32GF201J	
R324	Pot., Comp., 62 Ω ±5% 1/2 W	6100-0625	01121	RC20GF620J	5905-279-1760
R325	Pot., Comp., 10 Ω ±5% 1/2 W	6100-0105	01121	RC20GF100J	5905-190-8883
R326	Pot., Comp., 240 Ω ±5% 1/2 W	6100-1245	01121	RC20GF241J	5905-279-2593
R327	Pot., Comp., 500 Ω ±20%	6040-0300	01121	FWC, 500 Ω ±20%	5905-072-7795
R329	Film, 75 Ω ±1%	6550-0075	75042	MEF-TO, 75 Ω ±1%	
R330	Film, 536 Ω ±1% 1/8 W	6250-0536	75042	CEA, 536 Ω ±1%	
R331	Composition, 430 Ω ±5% 1/2 W	6100-1435	01121	RC20GF431J	5905-279-3512
R332	Composition, 43 Ω ±5% 1/2 W	6100-0435	01121	RC20GF430J	5905-279-1887
R333	Composition, 1 kΩ ±5% 1/2 W	6100-2105	01121	RC20GF102J	5905-195-6806
R334	Composition, 130 Ω ±5% 1/2 W	6100-1135	01121	RC20GF131J	5905-252-5436
R335	Thermistor, 500 Ω ±10%	6740-1607	02606	LA25L2	
R336	Composition, 1.8 kΩ ±5% 1/2 W	6100-2185	01121	RC20GF182J	5905-190-8881
R337	Composition, 47 Ω ±5% 1/2 W	6100-0475	01121	RC20GF470J	5905-252-4018
R338	Composition, 4.7 Ω ±5% 1/4 W	6099-9475	01121	Type CB, 4.7 Ω ±5%	
R901	Film, 142.3 Ω ±1%	6610-1300	03888	A3AJ01	
R902	Film, 96.2 Ω ±1%	6610-1200	03888	A3AJ01-E	
R903	Film, 142.3 Ω ±1%	6610-1300	03888	A3AJ01	

PARTS LIST (Cont)

Ref. No.	*Description*	*Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
RESISTORS (cont)					
R904	Film, 96.2 Ω ±1%	6610-1200	03888	A3AJ01-E	
R905	Film, 142.3 Ω ±1%	6610-1300	03888	A3AJ01	
R906	Film, 96.2 Ω ±1%	6610-1200	03888	A3AJ01-E	
R907	Film, 142.3 Ω ±1%	6610-1300	03888	A3AJ01	
R908	Film, 96.2 Ω ±1%	6610-1200	03888	A3AJ01-E	
R909	Film, 142.3 Ω ±1%	6610-1300	03888	A3AJ01	
R910	Film, 96.2 Ω ±1%	6610-1200	03888	A3AJ01-E	
R911	Film, 142.3 Ω ±1%	6610-1300	03888	A3AJ01	
R912	Film, 96.2 Ω ±1%	6610-1200	03888	A3AJ01-E	
R913	Film, 142.3 Ω ±1%	6610-1300	03888	A3AJ01	
R914	Film, 96.2 Ω ±1%	6610-1200	03888	A3AJ01-E	
R915	Film, 142.3 Ω ±1%	6610-1300	03888	A3AJ01	
R916	Film, 65.8 Ω ±1%	6610-0900	03888	A3AG01	
R923	Composition, 100 Ω ±5% 1/2 W	6100-1105	01121	RC20GF101J	5905-190-8889
R924	Thermistor, 100 Ω ±10%	6740-1606	02606	Type LB21J1	
R925	Composition, 22 Ω ±5%	6095-0022	01121	HM, 22 Ω ±5%	
MISCELLANEOUS					
CR301	Type IN3604	6082-1001	24446	IN3604	5961-995-2199
CR302	Type IN3604	6082-1001	24446	IN3604	5961-995-2199
L301	Choke, Molded, 0.15 μH ±10%	4300-0101	99800	1536, 0.15 μH ±10%	
L302	Choke, Molded, 0.15 μH ±10%	4300-0101	99800	1536, 0.15 μH ±10%	
L303	Choke, Molded, 10 μH ±10%	4300-2200	99800	1536,10 μH ±10%	
M901		5730-1411	24655	5730-1411	

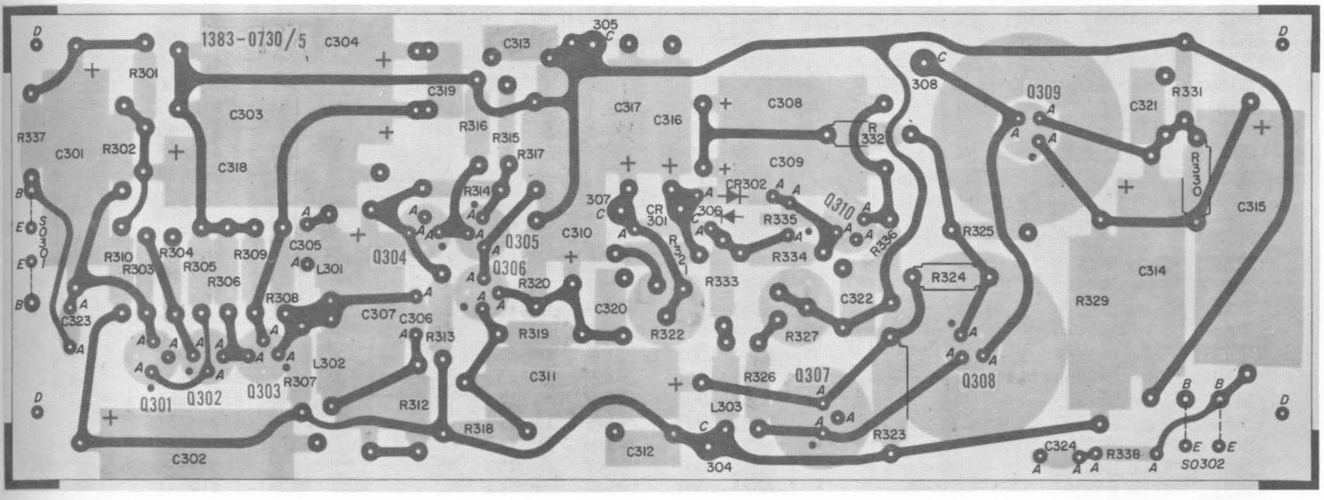
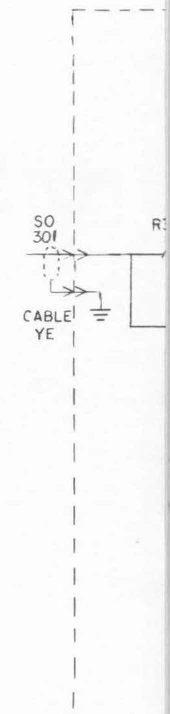


Figure 8-8. Etched-circuit board assembly for the video amplifier and attenuator. The complete board is P/N 1383-2731.



NOTE: The number appearing on the foil side is not the part number. The dot on the foil at the transistor socket indicates the collector lead.

SW

1. POSITION OF R
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SUPPLIED IN IN
3. REFER TO SERV
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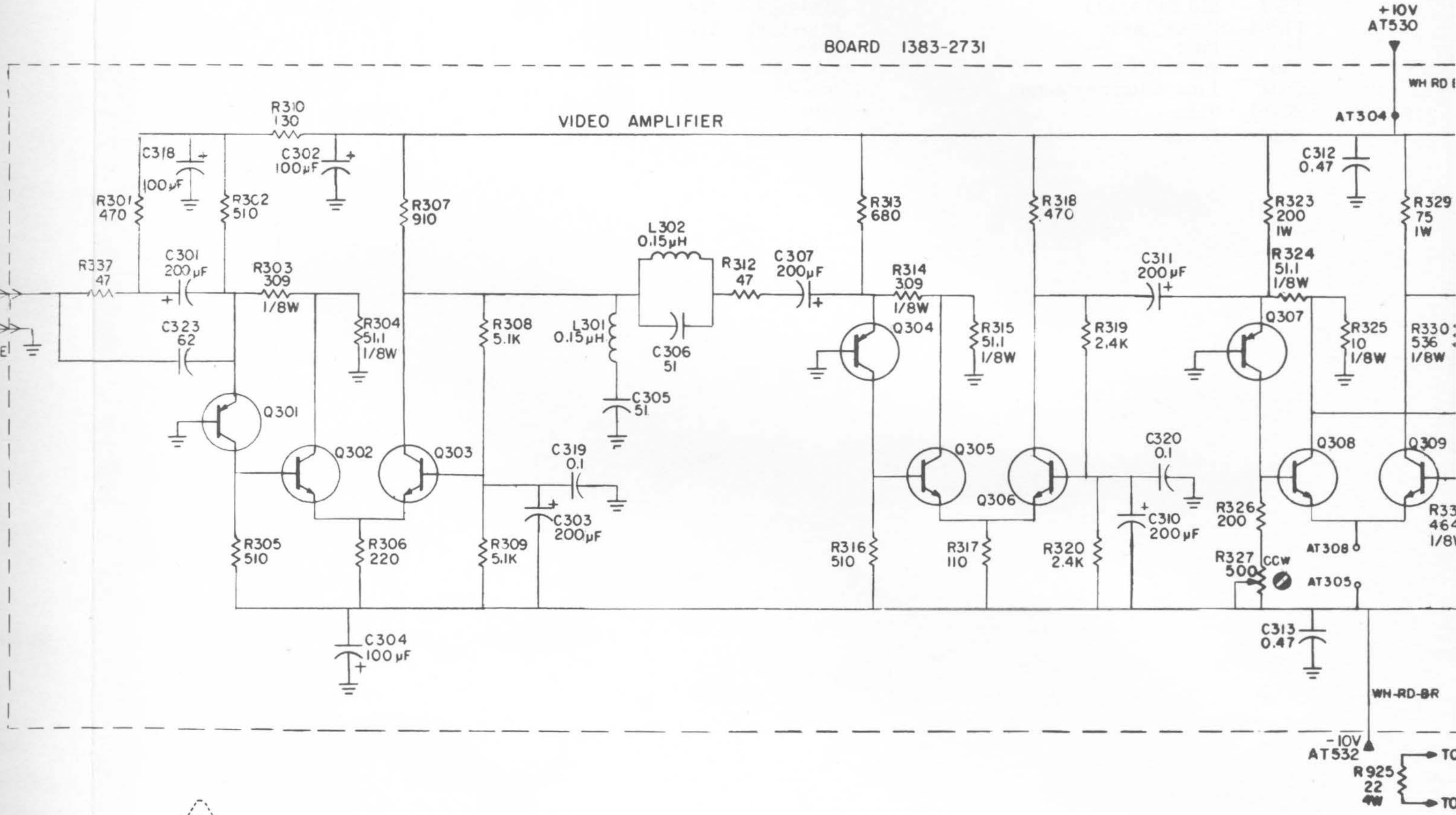
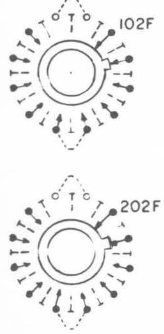
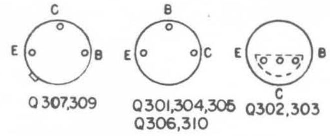
APPEARING ON
4. RESISTORS 1/2





SWITCHING DIAGRAM S901



BOTTOM VIEW OF TRANSISTORS

NOTE UNLESS SPECIFIED

1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE.
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK.
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM.
4. RESISTORS 1/2 WATT.
5. RESISTANCE IN OHMS K - 1000 OHMS M - 1 MEGOHM
6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS. LESS THAN ONE IN MICROFARADS.
7. ○ KNOB CONTROL
8. ⊘ SCREWDRIVER CONTROL
9. AT - ANCHOR TERMINAL
10. TP - TEST POINT

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.

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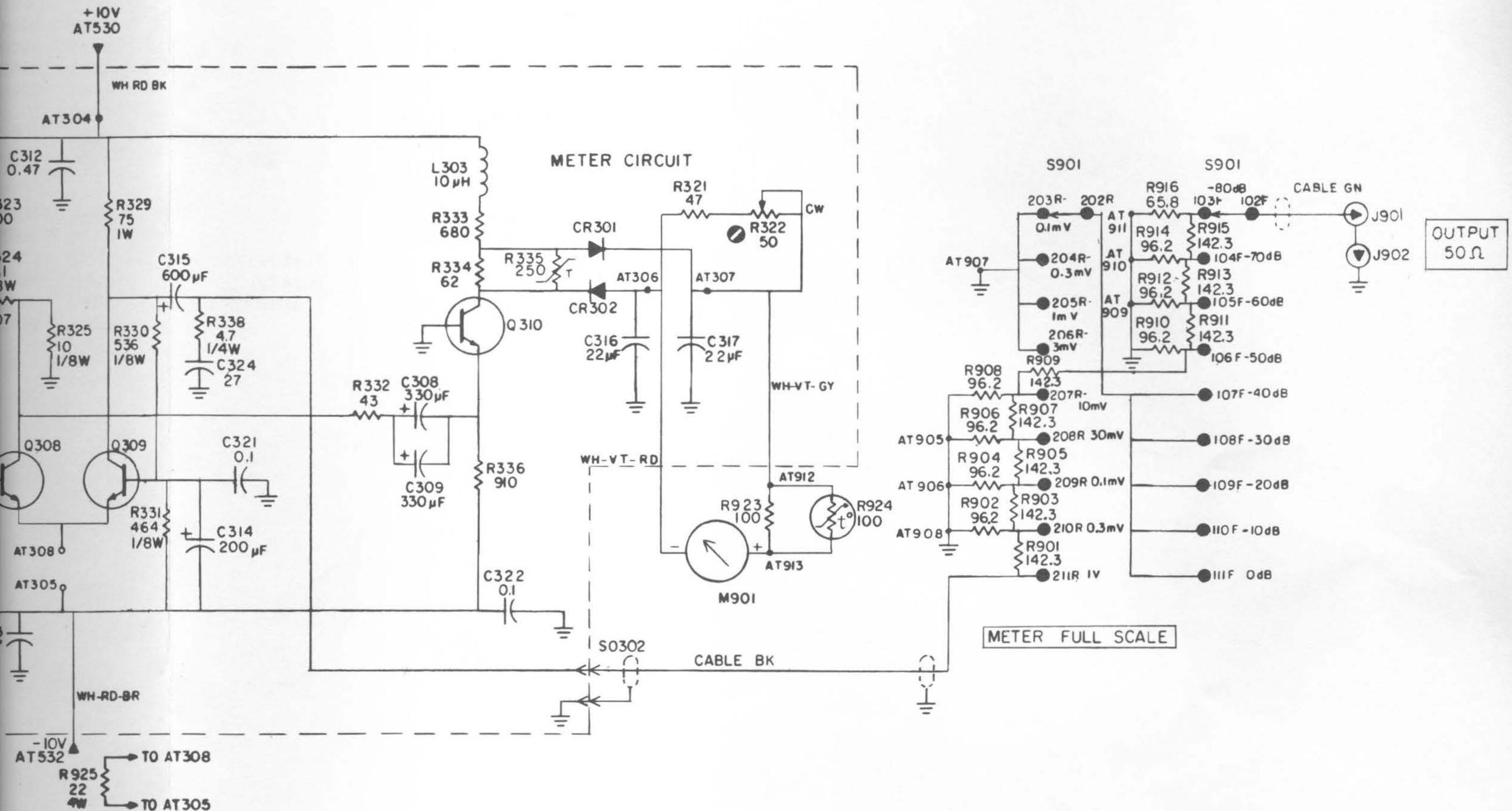


Figure 8-9. Schematic circuit diagram of the video amplifier and attenuator.

PARTS LIST

Ref. No.	Description	GR Part No.	Fed. Mfg. Code	Mfg. Part No.	Fed. Stock No.
CAPACITORS					
C501	Ceramic, 0.01 µF +80-20% 500 V	4406-3109	72982	811, 0.01 µF +80-20%	5910-754-7049
C502	Ceramic, 0.0068 +80-20% 500 V	4406-2689	72982	811, 0.0068 +80-20%	
C503	Electrolytic, 3600, 1800, 1800 µF +100-10% 10 V	4450-5609	80183	D-38841	
C504	Electrolytic, 450, 225, 225 µF +100-10% 100 V	4450-4000	74861	1B850RT	5910-448-5397
C505	Electrolytic, 1500, 750, 750 µF +100-10% 25 V	4450-0700	90201	203828S10C10X2	5910-976-9415
C506	Electrolytic, 1500, 750, 750 µF +100-10% 25 V	4450-0700	90201	203828S10C10X2	5910-976-9415
C507	Electrolytic, 1500, 750, 750 µF +100-10% 25 V	4450-0700	90201	203828S10C10X2	5910-976-9415
C508	Electrolytic, 1500, 750, 750 µF +100-10% 25 V	4450-0700	90201	203828S10C10X2	5910-976-9415
C509	Ceramic, 0.01 µF +80-20% 500 V	4406-3109	72982	811, 0.01 µF +80-20%	5910-754-7049
C510	Ceramic, 0.01 µF +80-20% 500 V	4406-3109	72982	811, 0.01 µF +80-20%	5910-754-7049
C511	Electrolytic, 200 µF +150-10% 6 V	4450-2610	37942	TT, 200 µF 6 V	5910-945-1836
C512	Ceramic, 470 pF ±10% 500 V	4404-1478	72982	831, 470 pF ±10%	
C513	Electrolytic, 100 µF +150-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C514	Ceramic, 0.47 µF ±20% 25 V	4400-2054	80183	5C13, 0.47 µF ±20%	5910-974-5696
C515	Electrolytic, 200 µF +150-10% 6 V	4450-2610	37942	TT, 200 µF 6 V	5910-945-1836
C516	Ceramic, 0.1 µF ±20% 25 V	4400-2050	80183	5C13, 0.1 µF	5910-974-5695
C517	Ceramic, 0.1 µF ±20% 25 V	4400-2050	80183	5C13, 0.1 µF	5910-974-5695
C518	Ceramic, 0.47 µF ±20% 25 V	4400-2054	80183	5C13, 0.47 µF ±20%	5910-974-5696
C519	Ceramic, 0.01µF +80-20% 500 V	4406-3109	72982	811, 0.01µF +80-20%	5910-754-7049
C520	Electrolytic, 15 µF +150-10% 15 V	4450-3700	37942	TT, 15 µF 15 V	
DIODES					
CR501	Type IN4140	6081-1014	13327	IN4140	
CR502	Type IN4140	6081-1014	13327	IN4140	
CR503	Type IN4140	6081-1014	13327	IN4140	
CR504	Type IN4140	6081-1014	13327	IN4140	
CR505	Type IN3253	6081-1001	79089	IN3253	5961-814-4251
CR506	Type IN3253	6081-1001	79089	IN3253	5961-814-4251
CR507	Type IN3253	6081-1001	79089	IN3253	5961-814-4251
CR508	Type IN3253	6081-1001	79089	IN3253	5961-814-4251
CR509	Type IN3253	6081-1001	79089	IN3253	5961-814-4251
CR510	Type IN3253	6081-1001	79089	IN3253	5961-814-4251
CR511	Type IN3253	6081-1001	79089	IN3253	5961-814-4251
CR512	Type IN3253	6081-1001	79089	IN3253	5961-814-4251
CR513	Type IN4009	6082-1012	24446	IN4009	5961-892-8700
CR514	Type IN750A	6083-1028	07910	IN750A	5960-754-5897
CR515	Type IN4009	6082-1012	24446	IN4009	5961-892-8700
TRANSISTORS					
Q501	Type 2N3905	8210-1114	04713	2N3905	
Q502	Type 2N3903	8210-1132	93916	2N3903	
Q503	Type 2N3740	8210-1121	93916	2N3740	
Q504	Type 2N3905	8210-1114	04713	2N3905	
Q505	Type 2N3903	8210-1132	93916	2N3903	
Q506	Type 40250	8210-1095	12672	40250	
RESISTORS					
R501	Composition, 7.5 kΩ ±5% 1/2 W	6100-2755	01121	RC20GF752J	5905-249-4195
R502	Composition, 620 Ω ±5% 1/2 W	6100-1625	01121	RC20GF621J	5905-279-1761
R503	Low Power Wire Wound, 2.7 Ω ±10% 2 W	6760-9279	75042	BWH, 2.7 Ω ±10%	5905-794-3857
R504	Low Power, Wire Wound, 2.7 Ω ±10% 2 W	6760-9279	75042	BWH, 2.7 Ω ±10%	5905-794-3857
R505	Low Power, Wire Wound, 2.2 Ω ±10% 2 W	6760-9229	75042	BWH, 2.2 Ω ±10%	
R506	Composition, 33 Ω ±5% 1/2 W	6100-0335	01121	RC20GF330J	5905-192-4490
R507	Composition, 680 Ω ±5% 1/2 W	6100-1685	01121	RC20GF681J	5905-195-6791
R508	Composition, 33 Ω ±5% 1/2 W	6100-0335	01121	RC20GF330J	5905-192-4490
R509	Composition, 330 Ω ±5% 1/2 W	6100-1335	01121	RC20GF331J	5905-192-3971
R510	Composition, 100 Ω ±5% 1/2 W	6100-1105	01121	RC20GF101J	5905-190-8889
R511	Composition, 510 Ω ±5% 1/2 W	6100-1515	01121	RC20GF511J	5905-279-3511
R512	Composition, 330 Ω ±5% 1/2 W	6100-1335	01121	RC20GF331J	5905-192-3971
R513	Composition, 330 Ω ±5% 1/2 W	6100-1335	01121	RC20GF331J	5905-192-3971
R514	Composition, 330 Ω ±5% 1/2 W	6100-1335	01121	RC20GF331J	5905-192-3971
R515	Composition, 33 Ω ±5% 1/2 W	6100-0335	01121	RC20GF330J	5905-192-4490
R516	Composition, 680 Ω ±5% 1/2 W	6100-1685	01121	RC20GF681J	5905-195-6791
R517	Composition, 33 Ω ±5% 1/2 W	6100-0335	01121	RC20GF330J	5905-192-4490
R518	Low Power, Wire Wound, 2.2 Ω ±10% 2 W	6760-9229	75042	BWH, 2.2 Ω ±10%	
R519	Composition, 75 Ω ±5% 1/2 W	6100-0755	01121	RC20GF750J	5905-279-1758
R520	Composition, 1.5 kΩ ±5% 1/2 W	6100-2155	01121	RC20GF152J	5905-841-7461

PARTS LIST (Cont)

Ref. No.	Description	Part No.	FMC	Mfg. Part No.	Fed. Stock No.
RESISTORS (cont)					
R521	Film, 5.11 kΩ ±1% 1/4 W	6350-1511	75042	CEB, 5.11 kΩ ±1%	
R522	Composition, 1.6 kΩ ±5% 1/2 W	6100-2165	01121	RC20GF162J	5905-279-3507
R523	Film, 4.42 kΩ ±1% 1/4 W	6350-1442	75042	CEB, 4.42 kΩ ±1%	
R524	Composition, 100 Ω ±5% 1/2 W	6100-1105	01121	RC20GF101J	5905-190-8889
R525	Pot., Wire Wound, 1 kΩ ±10%	6056-0138	11236	115, 1 kΩ ±10%	
MISCELLANEOUS					
F501	S10-B10 6/10A	5330-1100	71400	MDL, .6 Amp	5920-280-3161
F502	S10-B10 3/10A	5330-0800	71400	MDL, .3 Amp	5920-235-8362
PL501	Power, Input	4240-0600	91146	45D02	
P501	Pilot	5600-0309	71744	#330	
S501	Power/OFF	7910-1300	04009	83053-SA	5930-909-3510
S502	Line Voltage Selector	7910-0831	42190	4603	
SO901	Tube	7530-0200	81350	TS102C01	5935-232-3758
T501	Power	0485-4037	24655	0485-4037	

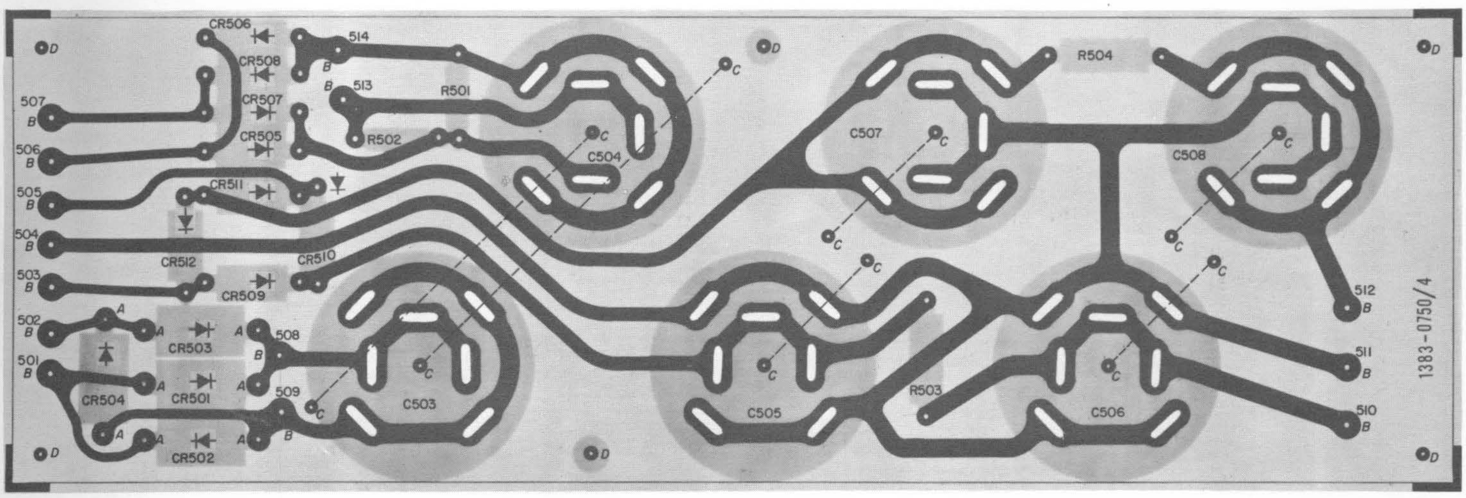


Figure 8-10. Etched-circuit-board assembly for the power-supply. The complete board is P/N 1383-2750.

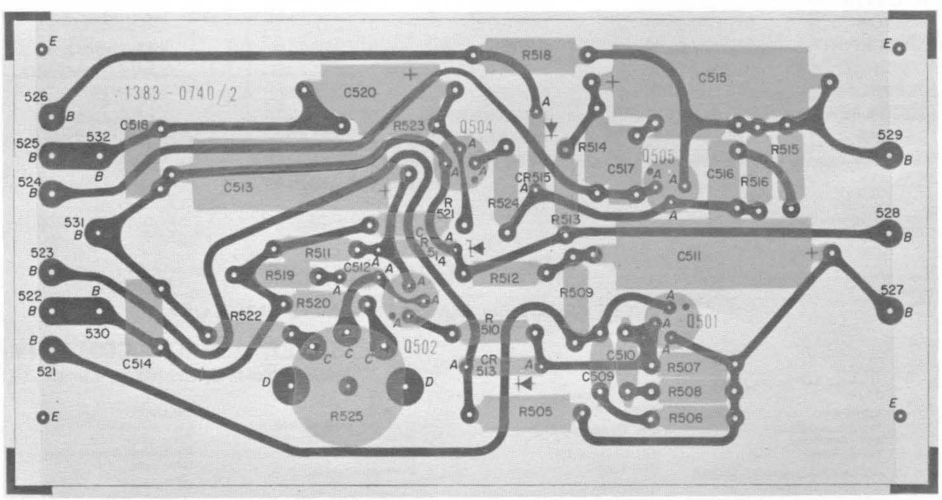
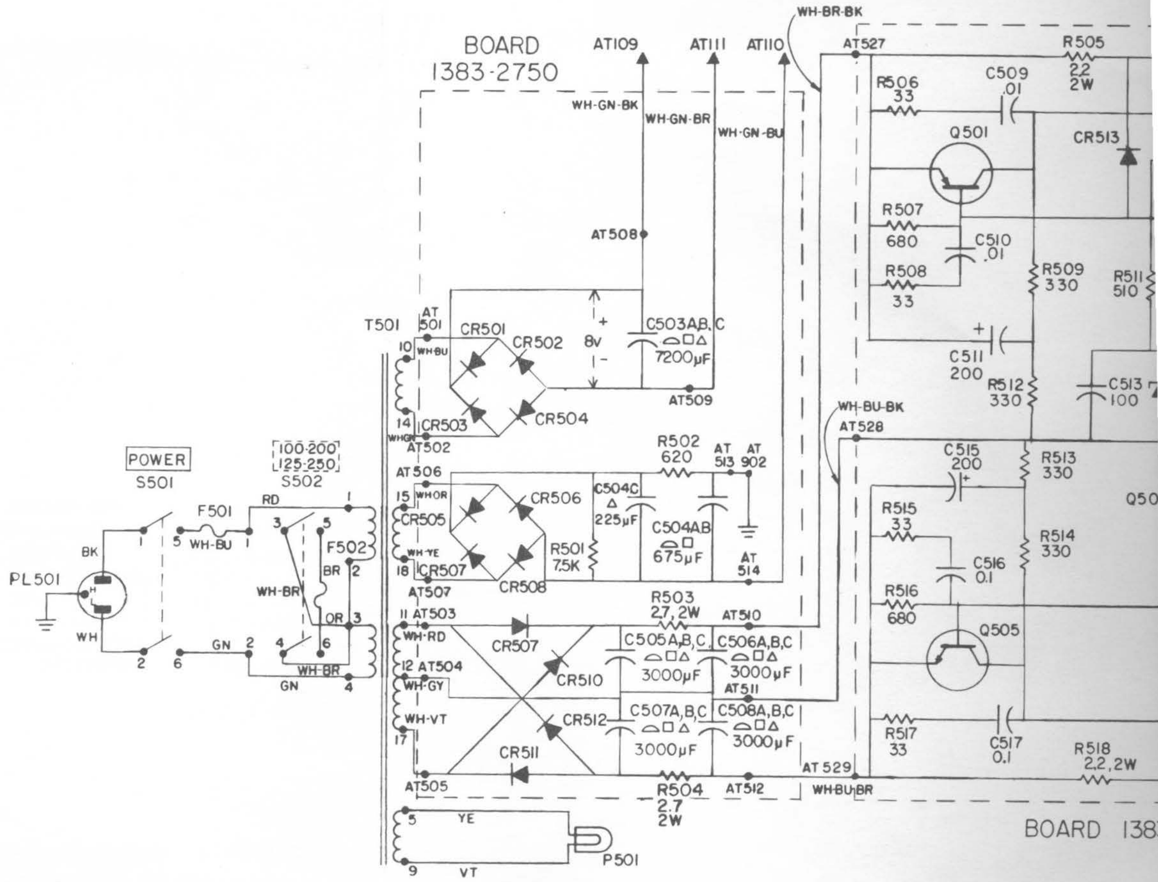
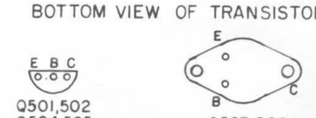


Figure 8-11. Etched-circuit-board assembly for the ±10 V regulator circuit. The complete board is P/N 1383-2741.

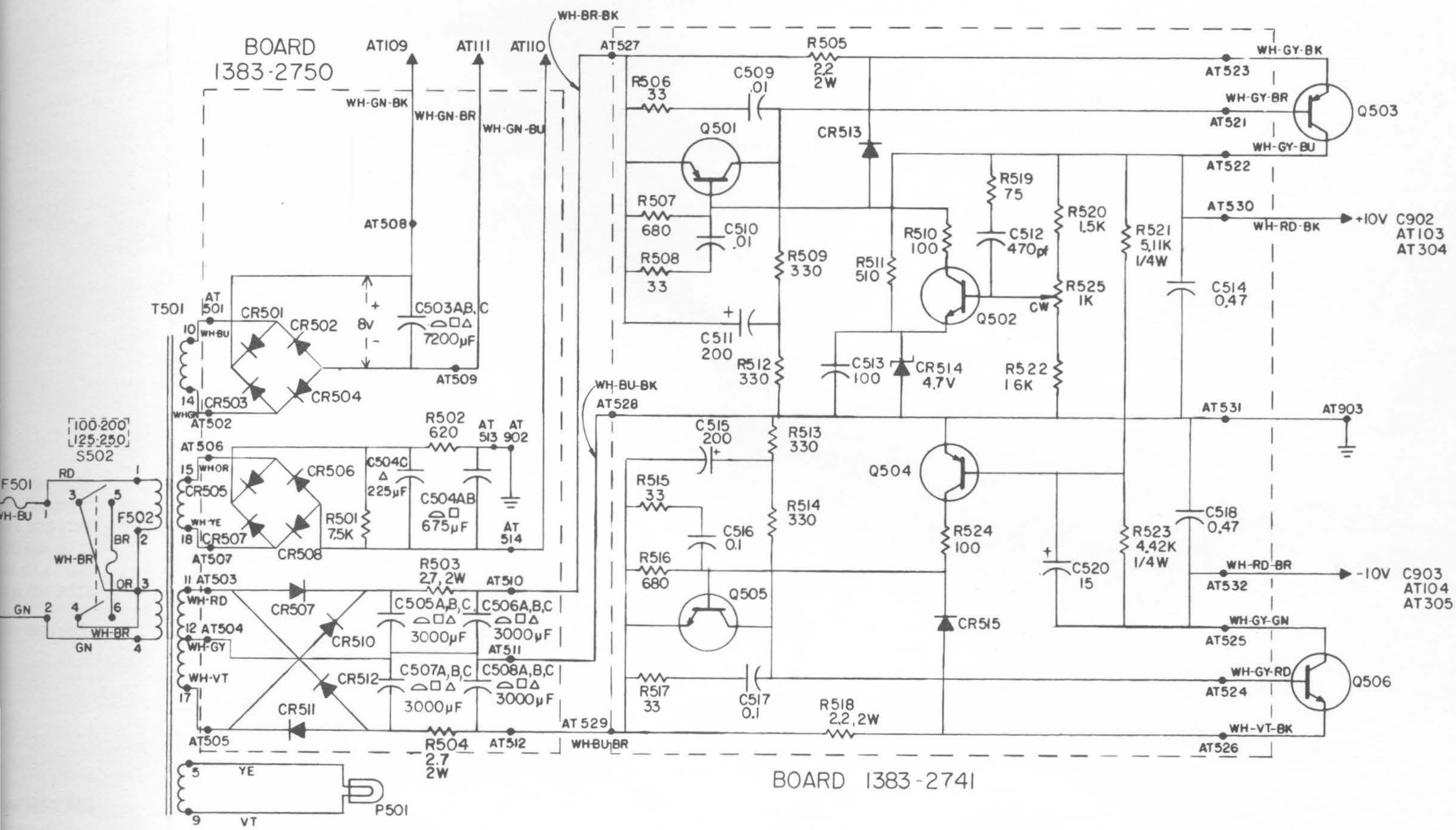
NOTE: The number appearing on the foil side is not the part number. The dot on the foil at the transistor socket indicates the collector lead.



BOTTOM VIEW OF TRANSISTORS



NOTE UNLESS SPECIFIED	
1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE.	5. RESISTANCE IN OHMS K = 1000 OHMS M = 1 MEGOHM
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK.	6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS, LESS THAN ONE IN MICROFARADS.
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM.	7. ◯ KNOB CONTROL
	8. ⦸ SCREWDRIVER CONTROL
	9. AT - ANCHOR TERMINAL
4. RESISTORS 1/2 WATT.	10. TP - TEST POINT



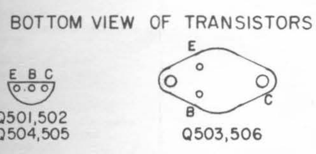


Figure 8-12. Schematic circuit diagram of the power supply.

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ITCHES EET OOK.	6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS. LESS THAN ONE IN MICROFARADS.
INSTR- S	7. ◯ KNOB CONTROL
	8. ⦸ SCREWDRIVER CONTROL
	9. AT = ANCHOR TERMINAL
	10. TP = TEST POINT

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