TELco MODEL 201 50 MC CONVERTER

25¢

TELCO

TAPETONE ELECTRONICS LABORATORIES INC.

99 Elm St., West Newton 65, Mass.

TELCO MODEL 201

50MC CONVERTER

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SECTION I
GENERAL DESCRIPTION

1.1 Introduction.

This Handbook describes the TELco Model 201, 50 megacycle converter. It includes information concerning its installation, adjustment, operation, and maintenance. The Model 201 converter converts signal frequencies in the 50 to 54 megacycle range to an intermediate frequency range of 14 to 18 megacycles. Power requirements are 150 volts DC at 40 MA and 6.3 volts at 1 ampere. R. F. input and intermediate frequency output are a nominal fifty ohms and employ type BNC connectors.

1.2 Design Philosophy.

The design objective during the development of the 201 Converter was to produce the best possible 50 megacycle converter. The finished design is clean of any compromise. Every effort has been made to provide best usable noise figure, the highest resistance to overload, and the best possible reduction of I. F. feedthrough. For example, one of the compromises found in converters of older design is the luxury of providing an I. F. output at any desired frequency. A survey of the market indicated that only one per cent of the available receivers for use in the I. F. system had sufficient R. F. selectivity at frequencies above 18 megacycles to yield optimum performance.

As a result the Model 201 is made in the 14 to 18 megacycle range only. The added selectivity provided by your receiver in this range insures maximum protection from overload by strong adjacent signals. The use of a single grounded grid nuvistor preamplifier insures optimum noise figure and maximum linearity without adding undesireable high gain. The 6U8 mixer was chosen as the result of an exhaustive test of all types of tubes to provide the maximum conversion gain to overload ratio.

SECTION II
INSTALLATION

2.1 Unpacking.

After unpacking the Model 201 converter, examine it closely for any possible damage which may have occured during transit. Should any sign of damage be apparent file a claim immediately with the carrier, stating the extent of the damage. Carefully check all shipping labels and tags for any special instructions before removing or destroying them.

2.2 Location.

The converter should be placed in a location which permits relatively short leads between the converter output and the input circuits to your receiver. (See Section 2.4 and 2.5)

2.3 Power Supply.

The power supply for the Model 201 is the Model 154 matching power supply. The power supply can be permanently attached to the converter. The mating plugs provide all the necessary connections.

If an external power supply is used, a B+ supply of 140 volts to 150 volts DC must be provided. Current required from this supply is 40 milliamperes. The filament requirements are 6.3 volts AC

or DC at one ampere. Connections for the use of an external power supply are provided in the scematic diagram of the converter. (Figure 6, Page 18)

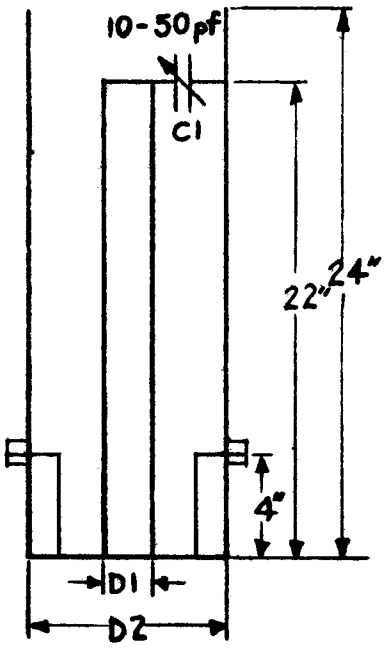
2.4 Connections to the Receiver. (Figure 1, Page 20)

The I. F. output from the converter is brought out through a type BNC connector. Output impedance is 50 ohms. Connection to the receiver should be made by means of RG58/AU or equivalent. The length of line that may be used between the converter and receiver will depend to a great extent upon the termination provided by the receiver. If your receiver input circuits do not properly terminate a 50 ohm line, excessive line lengths will introduce spurious signal pickup. On some receivers it may be necessary to provide a matching network to properly terminate the I. F. feedline. Optimum performance with the Model 201, or in fact any converter, will only be obtained when a proper match between the I. F. output of the converter and the input of the receiver has been achieved.

2.5 Coupling from the Antenna.

The input impedance of the Model 201 has been adjusted to give optimum performance when the signal is obtained from a flat 50 ohm line. If your feed line is not flat or is not 50 ohms a

matching device must be employed. Severaly matching schemes are shown in Figure 2. The use of the high "Q" filter shown in Figure 2 B is highly recommended in areas where high interference level from strong commercial stations is experienced. The 200 ohm to 50 ohm balun is for matching Federal KT-200 feedline. Consult your ARRL Antenna Handbook for more details.



$\frac{D1}{D2} = \frac{1}{4}$

COAXIAL CAVITY

FIG 2B

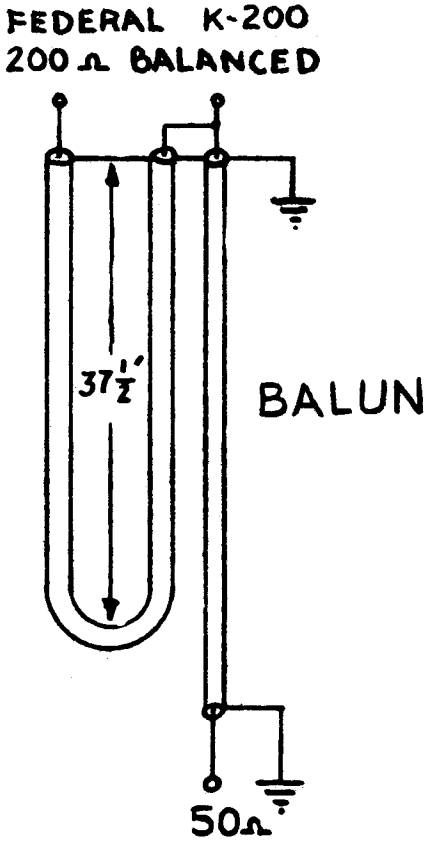


FIG 2A

SECTION III
OPERATION

3.1 Tuning Range.

The tuning range of the Model 201 is adjusted to provide optimum performance in the 50 to 54 megacycle range. To cover this range, the I. F. receiver must tune 14 to 18 megacycles.

3.2 System Gain Optimization.

When a converter has been connected to the receiving system as outlined in Section II, the I. F. receiver should be tuned to 14.5 megacycles. With the receiver operating controls set for normal operation the power to the converter should be turned on. The carrier level indication on the receiver should rise one to two "S" units. Ideally this noise increase should be between 3 and 6 db. If noise increase more than two "S" units the system will be subject to overloading by strong signals. If little or no noise increase is obtained trouble with I. F. feedthru is likely. Either situation requires attention if optimum system performance is to be obtained. The Model 201 has been designed to provide sufficient gain to yield a noise figure of 2.5 to 3 db when operating into an average receiver having one stage of R. F. amplification.

If your receiver has more than average gain an adjustable pad should be inserted

between the converter output and the receiver input. Such a pad is shown in Figure 3. Note that complete shielding of this device is mandatory if I. F. feedthru is to be avoided.

It is not possible for a properly operating receiver to have sensitivity so low that the Model 201 will not increase its noise output by at least 3 db. If, however, this situation obtains in your case it is recommended that you consult the service manual supplied with your receiver. As your receiver is a basic part of your system it is imperative that its performance is up to par.

3.3 Adjusting the Receiver.

In setting up your receiving system keep in mind the following points:

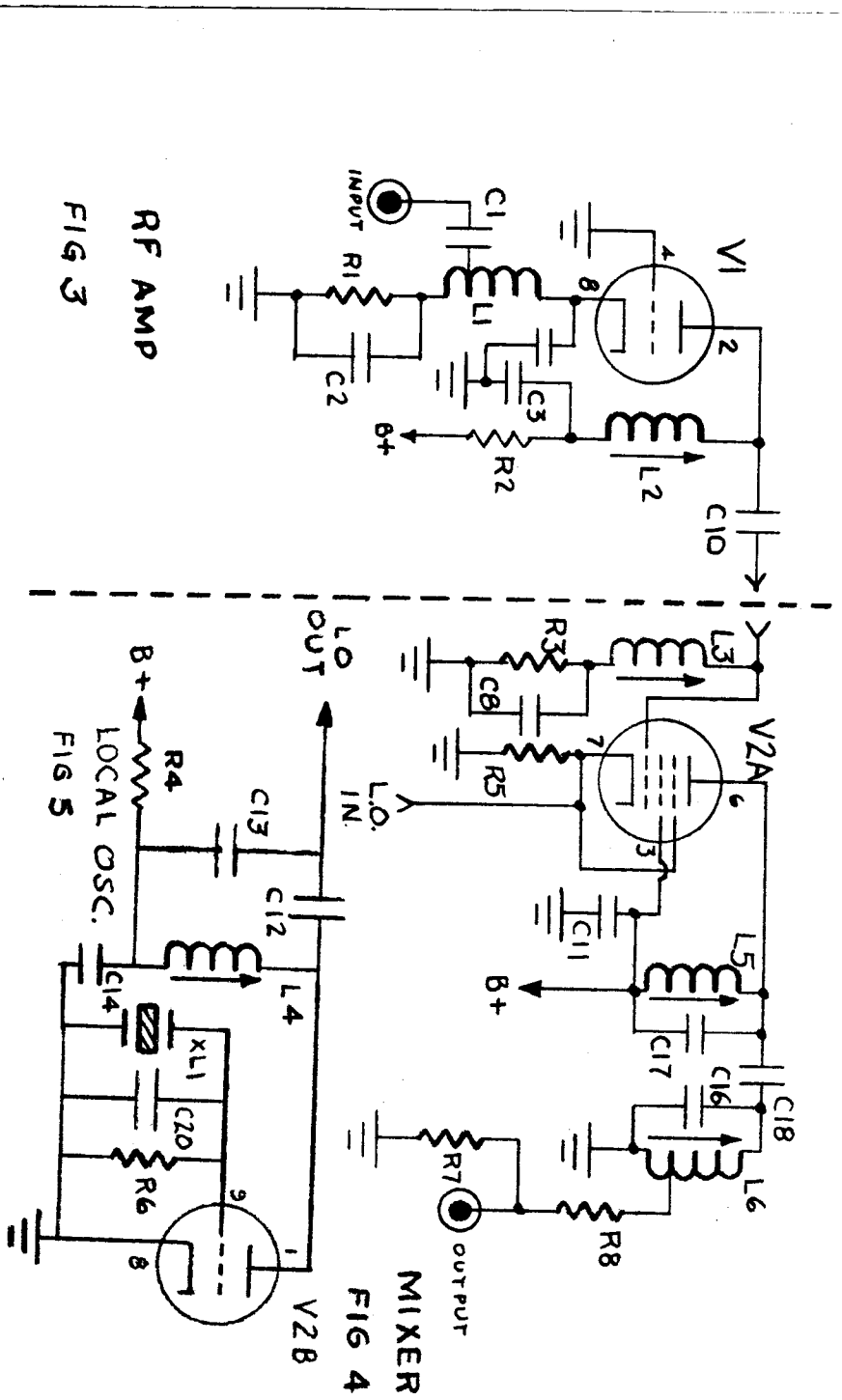
A) Excessively high "S" meter reading in the absence of signal indicates reduction in system overload capability.

B) The only valid signal report is in db or "S" units above the noise. If the noise level reads "S" 9 and the signal reads 12 db over 9 the report should be "S" 2. (You also should excuse yourself and sign off until you fix your receiving system.)

C) Under no circumstances is it desireable to reduce the "S" meter reading by detuning the antenna trimmer. This leaves you wide open for spurious signal interference.

D) Turning down the I. F. gain in the receiver does not accomplish the same result as using an I. F. pad between the converter and the receiver. Generally the I. F. (R.F.) gain control operates on the later stages of the receiver. This means that the excessive gain is occuring before selectivity is established. Cross modulation, developing in the receiver proper, will still occur regardless of the gain setting. Receivers equipped with a separate gain control on the R. F. amplifier stage of course do not suffer from this malady (ergo: NC300 series).

E) Checking system performance by removing the feedline from the converter input can lead to erroneous conclusions unless a 50 ohm noninductive resistor is used to replace the feedline. An increase in system noise should be experienced when such a "dummy" load is replaced with a "live" feedline. (There is still a possibility of confusion if your feedline has a very high VSWR).


INPUT
C1
R1
L1
C2
C3
V1
B+
R2
L2
C10
RF AMP
FIG 3
L.O. IN.
R3
L3
C8
R5
V2A
C11
L5
B+
C17
C16
C18
L6
R7
R8
OUTPUT
MIXER
FIG 4
L.O. OUT
B+
R4
LOCAL OSC.
FIG 5
C13
C12
L4
C14
XL1
C20
R6
V2B

SECTION IV
CIRCUIT DESCRIPTION

4.1 R. F. Amplifier.

The first stage of a frequency converter has the greatest effect on the overall performance. The most important points considered in this particular R. F. amplifier design were to achieve the lowest possible overall noise figure, while still keeping the first stage gain at a reasonable level. This is done to preserve the dynamic range of the succeeding stages.

The importance of R. F. amplifier performance can be seen in the following relation:

$$NF = \frac{nf2-1}{g1} + NF_1$$

Where NF = Overall Noise Figure
Where NF_1 = First Stage Noise Figure
Where NF_2 = Second Stage Noise Figure
Where g_1 = First Stage Gain

It is evident from the above relation that as the first stage gain is increased the second stage noise figure is decreased and therefore, the overall noise figure is decreased. But, as the gain is increased the possibility of overload and cross modulation is increased.

The Model 201 converter uses a 6CW4 "Nuvistor" type triode arranged in a grounded grid circuit. (See Figure 3)

The signal is applied through blocking capacitor (C1) into an impedance matching device and then to the cathode. It is then coupled from the plate through a capacitor to the following stage. As can be seen, the grid is the common element in this circuit and acts as a shield between the cathode and plate reducing the plate to cathode capacitance to a very low value. This insures stable operation free of the type of feedback that causes oscillation.

4.2 Mixer.

The mixer uses the pentode section of a 6U8 and is of the "Cathode Injection" variety. This can be seen in Figure 4.

Note that the plate of the R. F. amplifier and the grid of the mixer are connected to separate resonant circuits. This double tuned circuit insures a uniform frequency response over the entire band. Between these two coils a metal shield is inserted to prevent I. F. feedthru. This shield stops signals coupled through the antenna input at the I. F. frequency from entering the mixer and being amplified.

Amplified signal from the first stage is coupled through C-10 to the mixer grid and the output from the crystal oscillator is applied to the un-bypassed cathode.

A high "Q" tuned circuit is placed at the plate of the mixer and is resonant

at the I. F. frequency. This circuit in the plate offers a high impedance to I. F. voltage and a low impedance to signal and local oscillator voltages. Because of this high impedance the only signal passed through the coupling capacitor (C15) and on to L6 is the I. F. signal. L6 is an impedance matching coil which lowers the output impedance. The network of resistors from the tap on L6 comprise a pad giving an output impedance which properly terminates a 50 ohm line. The two coils, L5 and L6, compose another double tuned circuit to give uniform frequency response.

4.3 Local Oscillator.

The local oscillator, a standard Pierce circuit, is shown in Figure 5. This circuit was chosen to provide maximum stability and trouble free operation.

The oscillator uses a fifth overtone crystal in parallel resonance and oscillates at 36 MC. The coil L4 is parallel tuned for resonance at 36 MC. R. F. output is coupled to the mixer through C12.

4.4 Power Supply.

The power supply, shown in Figure 8, has been designed for dependable, trouble free operation. It employs a rugged transformer followed by a selenium rectifier. The filter is of the R/C type and provides positive reduction of AC ripple. Resistor R2 functions as a bleeder and voltage stabilizer.

SECTION V
SERVICE DATA

5.1 Removal from Box.

To remove the 201 from its box only the four mounting screws on the outer edge of each side need be removed. Once these have been taken out the box can be taken away from the converter.

5.2 Trouble Shooting.

If trouble is experienced with the 201 the following paragraphs may be of assistance. Voltages are measured with a 150V supply connected.

If the normal amount of noise output is not heard from the converter it is likely that the oscillator is not operating. A voltmeter connected across R4 will monitor the plate current of the oscillator tube V2B. The voltage across this resistor will be from 2-4 volts when the tube is oscillating and 8-10 volts when it is not oscillating.

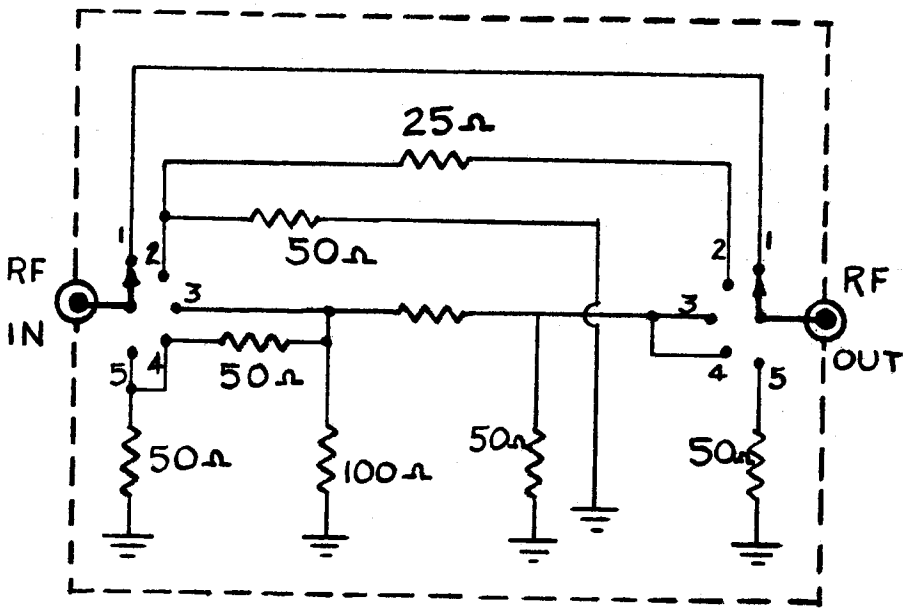
If the converter appears to have low gain or a high noise figure, check the current drawn by V1. This can be done by reading the voltage across R2. This voltage should be from 9-10 volts.

5.3 Alignment Procedure.

The alignment of this unit is not practical without the use of a sweep generator, detector, and oscilloscope. Alignment is accomplished by connecting a 50 MC sweep generator to the

R. F. input and connecting an oscilloscope through a 50 ohm detector to the R. F. output. Once it is set up and a response curve can be seen on the oscilloscope, the oscillator coil L4 should be adjusted for maximum gain. When this is done the R. F. coils (L2 and L3) and the I. F. coils (L5 and L6) should be adjusted for maximum gain and desired passband from 50-54 MC.

IF ATTENUATOR 0-10 db



PARTS LIST FOR TAPETONE
MODEL 201 NUVISTOR CONVERTER

RESISTORS

R1	100 ohms	10%	1/2W	Composition
R2	1K	10%	1/2W	"
R3	47K	10%	1/2W	"
R4	1K	10%	1/2W	"
R5	470	10%	1/2W	"
R6	1M	10%	1/2W	"
2- R7,R8	47	10%	1/2W	"

CAPACITORS

5- C1-C8,C11,C13,C14	470mmf	10%	1KV	Disk
C10	.47	5%	Jeffers	Cop.
3- C12, C15, C17	5	10%	1KV	Disk
2- C16, 19	10	10%	1KV	Disk
C9, C18	1000	GMV	1KV	Feed thru
1- C20	200mmf	10%	1KV	Disk

INDUCTORS

L1 9t BW3003
L2 20t #26 on 1/4 in. LSM form (white slug)
L3 14t #26 " " " " " " "
L4 20t #26 " " " " " " "
L5 28t #28 on PL5-5 form - (red slug)
L6 28t #28 on PL5-5 form - (red slug) Tap 7t from bottom
RFC 1, RFC 2 3.3 Micro henries
RFC 3, RFC 4 .68 Micro henries

TUBES V1 6CW4
V2 6U8

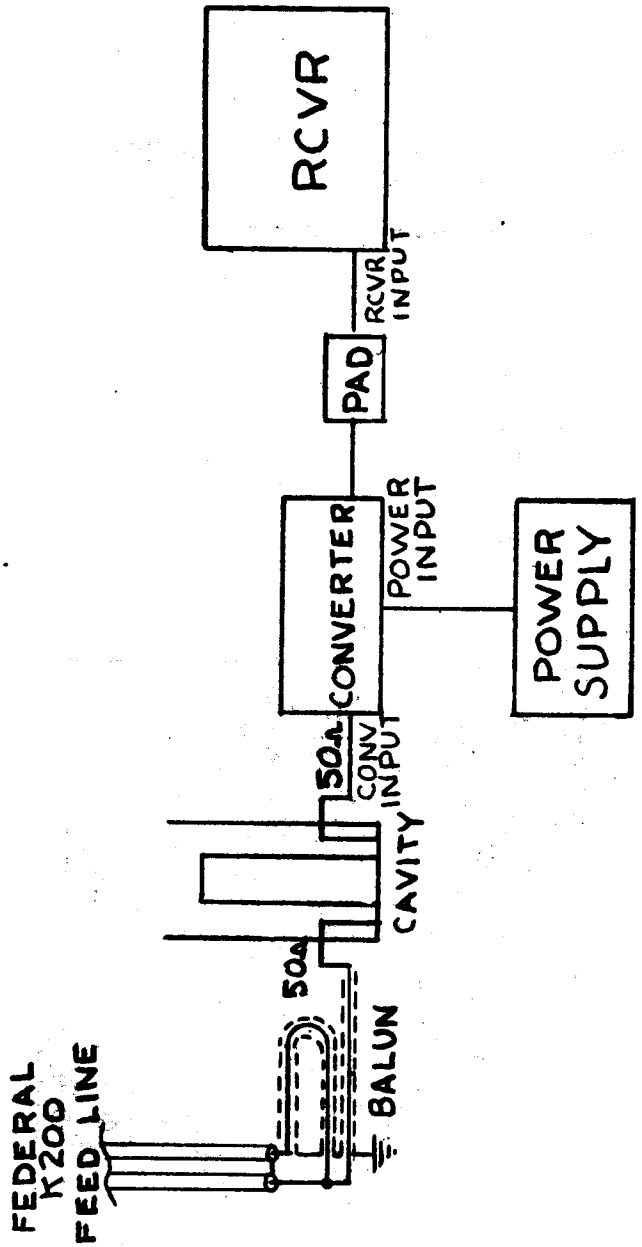
CRYSTAL

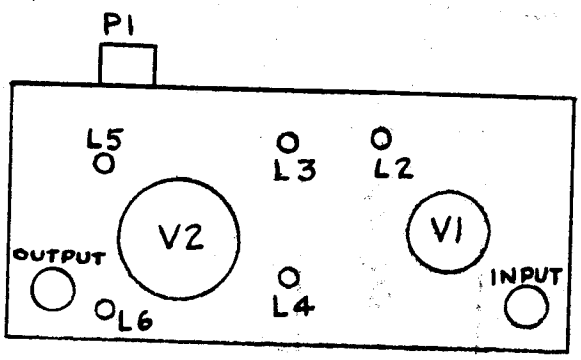
XL1 36.00 MC max.
P1 - 4 prong Jones plug (male)

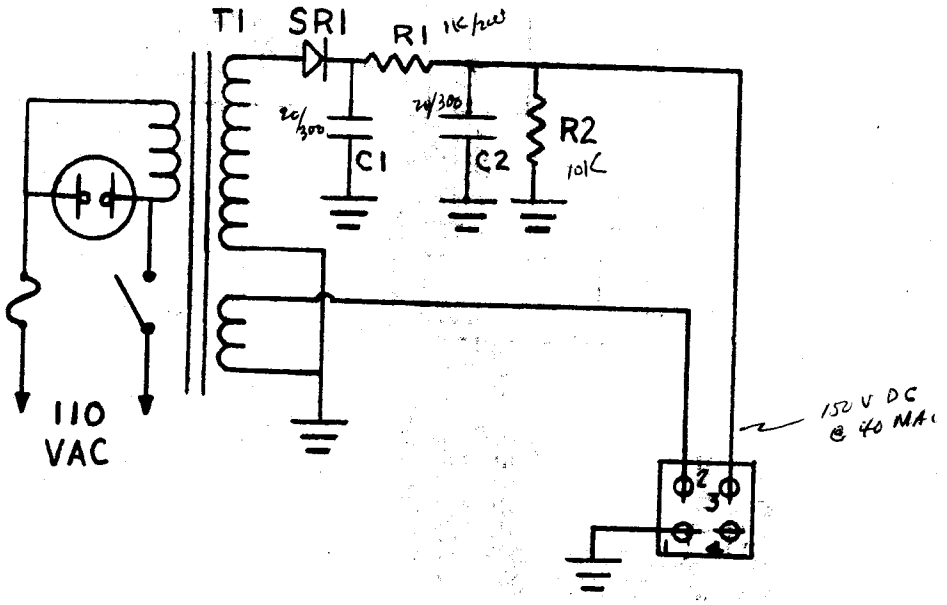
MODEL #154 PARTS LIST

T1 - TELco #T154
SR1 - Sarks Mod. 50
C1, C2 - 20-20 mfd 300 vdc dual section electrolytic
R1 - 1K 2 Watt
R2 - 10K ½ Watt
P2 - 4 prong Jones plug (female)

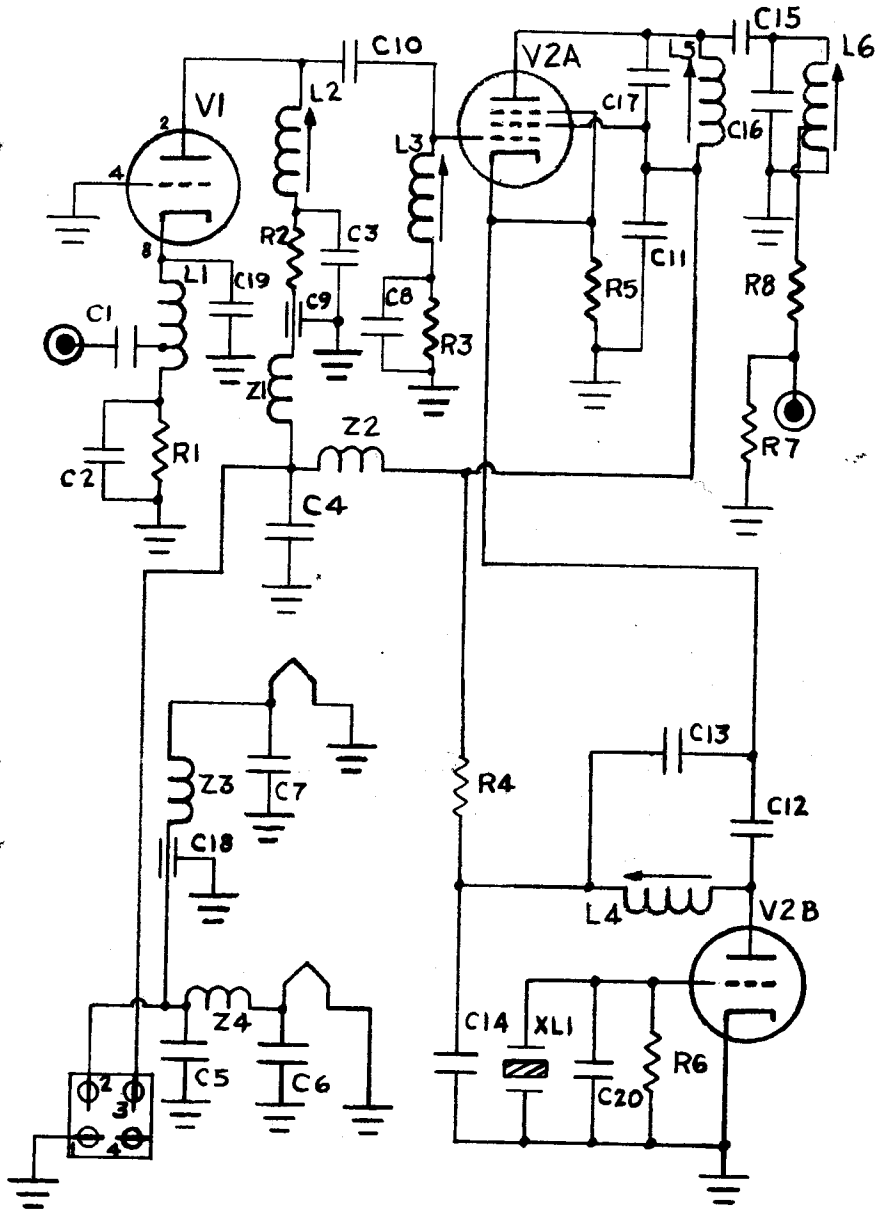
Converter Installation
Figure 1




P1
L5
L3
L2
V2
V1
OUTPUT
INPUT
L6
L4


T1
SR1
R1 1K/2W
2µ/300
C1
24/300
C2
R2
10K
110
VAC
152 V DC
@ 40 MA
2
3

Circuit Diagram for Model 201
Figure 7



The Tapetone Electronic Laboratories Inc. manufactures the finest quality UHF and VHF converters for Radio Amateurs. For many years our products have been used world wide by Space explorers and outstanding Amateurs. Our sterling reputation is maintained by producing the world's best VHF converters.

The TELco Model 201 is a high frequency converter designed for the Six Meter Band with a conventional communication type receiver.

The design objective during the development of the Model 201 was to produce the best possible Six Meter converter. The finished design is clean of any compromise. Every effort has been made to provide maximum usable noise figure, the highest resistance to overload, and the best possible reduction of I.F. feed thru.

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