COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

SERVICE BULLETIN

EQUIPMENT TYPE 75A-4 RECEIVER SERVICE BULLETIN NO. 2 DATE 10-15-56

SUBJECT: A. "S" METER SENSITIVITY POTENTIOMETER REPLACEMENT
B. MODIFICATION TO REDUCE HUM IN 75A-4
C. NOISE LIMITER MODIFICATION

SUBJECT A

"S" METER SENSITIVITY POTENTIOMETER REPLACEMENT

In the event that replacement of R41, "S" Meter SENS adjust potentiometer, becomes necessary, a new type CPN 377-0122-00, is recommended. The original potentiometer had an insulated rotor contact. The replacement potentiometer has a grounded rotor and must be insulated from the chassis. The following procedure is recommended where the replacement of R41 is necessary.

1. Mount the potentiometer, 100 ohm CPN 377-0122-00, to the two phenolic standoffs, CPN 500 8921 00, using two phillister head screws, CPN 347 0168 00. Place a solder lug, CPN 304 4200 00, under one of the mounting screws.

2. Remove old R41 from the chassis and mount the assembly of Step 1 above in its place, fastening with two 6-32 X ¼ binder head screws, CPN 343 0328 00.

3. Connect wire with orange and blue tracers to the terminal of the potentiometer.

4. Connect two wires with orange and green tracers to solder lug fastened to frame of potentiometer.

Additional parts required: Modification kit 542 0849 00

Qty	Description	Circuit Symbol	Collins Part Number
1	Resistor, Variable 100 ohm	R41	377 0122 00
2	Posts, Phenolic		500 8921 00
2	Screws, 6-32 X ¼ Phillister head		347 0168 00
2	Screws, 6-32 X ¼ Binder head		343 0328 00
1	Lug, Solder		304 4200 00

SUBJECT B
MODIFICATION TO REDUCE HUM IN 75A-4

An investigation of the hum present in the 75A-4 has shown that the four leads from the power transformer (T6) to the rectifier tube (V17) seem to be coupling rectified pulses into the circuitry of the BFO (V20). Shielding of these wires eliminate these pulses from the BFO circuitry.

In addition, the lead from the arm of the audio gain control R62 to pin 2 of V13 is tied in the cable in the audio chassis and is picking up some hum. Rerouting of this lead and the use of a shielded lead reduces this hum pick up.

Production units with serial numbers above 2715 incorporate these modifications. The following procedure is recommended for use on receivers with lower serial numbers which will substantially reduce the amount of hum present in the receiver. Refer to Figure 2.

1. Remove bottom cover from chassis.
2. Remove front panel from chassis.
3. Remove the yellow wires from V17 pins 2 and 8.
4. Remove the red wires from V17 pins 4 and 6.
5. Insert four wires removed in Step 3 and 4 above into shielding, CPN 425 0040 00.
6. Ground each end of shielding.
7. Resolder yellow wires to pins 2 and 8 of V17.
8. Resolder red wires to pins 4 and 6 of V17.
9. Unsolder wire from center contact of AF Gain, R62, on front panel. Tape this wire on to cabling.
10. Unsolder wire from pin 2 of V13 and tape this wire on to cabling.
11. After inserting shielded wire, CPN 439 7907 00 into sleeving, CPN 152 1312 00, connect this wire from center contact of R62 to pin 2 of V13. Route this wire as shown in Figure 2.

Additional parts required: Modification kit 542 0851 00

Qty	Description	Collins Part Number
0.6	Shielding (FT.)	425 0040 00
2	Wire, Shielded (FT.)	439 7907 00
1.8	Sleeving (FT.)	152 1312 00

SUBJECT C
NOISE LIMITER MODIFICATION

Recent research on the general subject of noise limiters and in particular on the noise limiter circuit used in the 75A-4 has prompted a modification to this circuit. The capacitors C147 and C148 were added to change the audio response characteristics of the receiver to a more desirable shape. They reduce the high frequency response and eliminate most of the high frequency components encountered in the pulse type noise. An additional section of filtering in the noise limiter bias supply has been incorporated to prevent any pulses that may appear on the AVC line and/or bias supply from feeding back through the noise limiter (V12). The bypass capacitors of both sections of this filter are now returned to the high side of a resistor (R118) which has been added to the AM detector circuit. This feeds a small amount of the pulses detected in the AM position to the cathode of the noise limiter. However, these pulses are out of phase with the pulses coming in on the plate and therefore help cancel out the pulses going through the noise limiter.

A noise pulse, when generated, is usually of a high amplitude and short time duration. This means that it contains many harmonics, or could be said to have a very wide bandwidth. So when a noise pulse is fed through a highly selective tuned circuit or a mechanical filter, only a certain portion of the original frequencies will come through. This has the effect of making a low amplitude and long time duration pulse out of what was originally a high amplitude and short time duration pulse. This means that even with the best limiter available it is sometimes very difficult to obtain much limiting action without also limiting the desired signal.

A very good explanation of this effect was given in an article by George Grammer, WIDF, in the May 1946 issue of QTS magazine. We quote a portion of that article to help clarify the explanation of the effect of selectivity on noise pulses.

NOISE PULSES AND SELECTIVITY

Fig. 1 gives a qualitative picture of noise and signal, but is by no means accurate in a quantitative sense when the circuit in which the oscillations exist is an IF amplifier operating in the vicinity of 450 kc. The number of cycles in the damped oscillation -- and therefore the length of time the oscillation persists, since the frequency is fixed -- is primarily a function of the Q of the circuit; the higher the Q the larger the number of cycles before the oscillation amplitude decays to a given fraction of the maximum amplitude. The normal 456 kc IF amplifier has an effective Q of such magnitude that even when excited by a signal pulse, several hundred cycles will occur before the amplitude dies down to a 1 per cent of its maximum value. Since Q and selectivity are directly related, an increase in selectivity brings with it an increase in the time required for damped oscillations to die down. This has an important bearing on noise reduction.

The noise that remains after full clipping will interfere to the extent that it tends to wipe out part of the beat note, and this in turn is a function of the length of time during which the noise exists. If the noise pulse is very short it may wipe out only a cycle or two of a beat frequency which usually lies between 500 and 1000 cycles per second, and the loss of one or two cycles is not likely to be noticed. On the other hand, if the time duration of the noise pulse is great enough the signal may be unreadable even though the maximum noise amplitude is limited to that of the signal. Since the time duration of the r-f noise oscillations increases with the selectivity of the IF amplifier, the rectified envelope of the noise pulse likewise lasts longer, and the effectiveness of a limiter decreases when the receiver selectivity is increased.

The seriousness of pulse lengthening depends upon the original strength of the pulse and the rate of pulse recurrence. The stronger the pulse the longer the time required for the amplitude to die down to a fixed level, and if the pulses occur in rapid succession they may even overlap when lengthened out by selectivity. The rate of recurrence of most noises seems to be in the neighborhood of 120 per second (many noises are associated with the power-line frequency) so the time during which the noise pulse amplitude is comparable to that of the desired signal has to be held to considerably less than 1/120th second if limiting is to do any good.

The effect of selectivity on the shape of noise pulses can be observed quite readily on an oscilloscope if a recurrent pulse is available for examination. Fig. 4 shows progressively increasing selectivity from normal IF to the maximum available with a crystal filter. Note that the selectivity reduces the maximum amplitude in addition to increasing the time duration. It is entirely possible for the maximum pulse amplitude to be reduced to such an extent that it does not exceed the amplitude of the desired signal--in which event, although limiting is useless, there is nevertheless an improvement in the signal-to-noise ratio. The effect is readily observable by switching a crystal filter in and out when there is ignition noise of moderate strength; it usually makes the difference between copying and not copying a weak signal. Yet with normal IF selectivity and a good limiter it would be possible to clip the noise pulses so effectively they would not even be heard. It would be easy to interpret this last statement to mean that high selectivity is somewhat of a handicap in the presence of impulse noise, but despite the fact that there are occasions when it becomes possible to copy a signal with normal IF selectivity, plus limiting, and impossible to copy the same signal through a crystal filter, it would not pay to jump to such a conclusion.

CONTINUOUS NOISE

In the final analysis all noise is of a pulse-like nature, but when the pulses are random and occur so frequently that they overlap even though they are of extremely short duration, the result is a hiss-like noise of more or less uniform average intensity. This is the familiar receiver hiss, much of it generated in the circuits and tubes, but some of it similarly random noise picked up by the

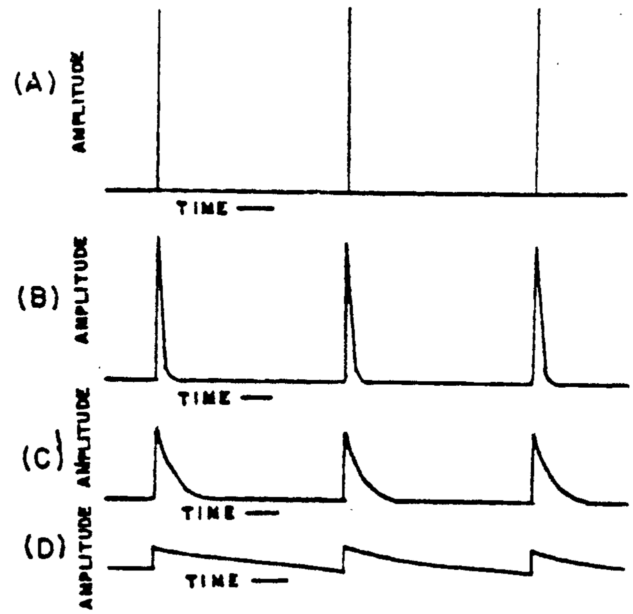


Fig. 4—Effect of increasing selectivity on the shape of noise pulses. (A) shows the pulse as it might appear with normal i.f. selectivity, (B) with a broad crystal filter, (C) and (D) with progressively increasing selectivity. These drawings, although not to true amplitude scale, shows the effect of high selectivity in decreasing the amplitude of a pulse. They were made from oscilloscope patterns using a loran signal, the pulse intervals being approximately 1/18th second. With maximum selectivity (D) most of the pulse interval is required for the pulse amplitude to decrease to a negligible value.

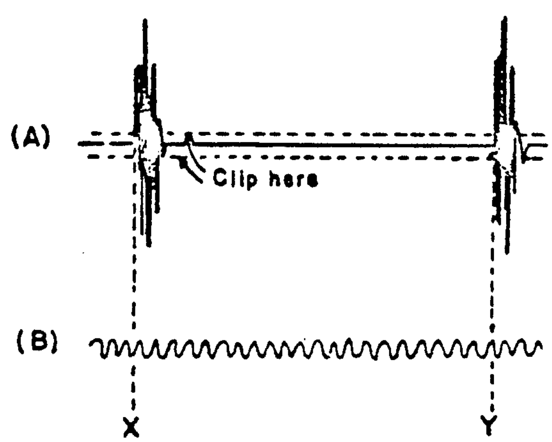


Fig. 1—Representation of noise impulses compared with a continuous carrier.

antenna. The energy distribution does not exist in short, high-amplitude bursts with relatively long silent periods between; it is continuous in time and there is no sense in expecting a limiter to reduce it.

On the other hand, this is the very type of noise that is reduced by increased selectivity; it is spread out over the whole frequency spectrum and the higher the selectivity the smaller the amount of it that is passed out by the selective circuits. Weak signals that are unreadable in the hiss noise with normal IF selectivity become readable with a crystal filter because the selectivity reduces the noise without changing the signal strength. When impulse noise is added to the hiss it may or may not be possible to copy a signal through the filter, but it certainly will not be possible without it even though the limiter does a perfect job of taking out the noise impulses. However, if the signal can be copied through the hiss with normal IF selectivity a good limiter usually will prevent impulse noise from interfering; whether or not the same signal can be copied with the crystal filter is a matter of the amplitude and character of the noise and the degree of selectivity. Ultimately, the noise pulses passing through the filter may result in a continuous "ringing" through which no signal can be copied, simply because the pulses are of such amplitude and have been lengthened to such an extent that they overlap to produce what is practically a continuous wave. This requires a noise amplitude such that with normal IF selectivity and without limiting, the signal is so deeply buried in noise as to be completely undiscernible to the ear. But if the noise is of the high-amplitude, short-duration character a good limiter will not only make the signal audible but make it perfectly readable.

This makes a convincing demonstration of the usefulness of a noise limiter, but the occasions when it can be done are relatively infrequent. The more common case is the one where the noise amplitude is such that either the crystal or normal-IF-plus-limiter will make the signal readable. With the filter, the limiter gets only an occasional chance to work because the noise amplitude is reduced by the selectivity; the result is that the impulse noise is there even though it may not prevent making perfect copy. With the normal-IF-plus-limiter the noise may be eliminated almost 100 per cent but the hiss is much stronger and the selectivity against other stations is much reduced. Which is better depends upon the operator's likes and the conditions--noise and other interference--existing at the moment.

There are at least two other types of noise that tend to be continuous and therefore hard to handle with a limiter insofar as increasing signal readability is concerned. One is natural static; if it is stronger than the signal the latter is likely to be blotted out completely for the duration of the crash. The other is associated with some electrical devices in which the sparking appears to be practically continuous during the half of each a-c alternation when the voltage is highest, with the result that for about half the time the noise pulses are overlapping. When a limiter is applied on such a noise the residue is a throttled-sounding buzz.

The End

Since the effective Q of the mechanical filters used in the 75A-4 is relatively high, it can be seen that a problem with impulse type noise does exist.

We have made some modifications to the noise limiter circuit used in the 75A-4, serial number 2716 and above, and these modifications are described below. While the modification provides somewhat better operation, the basic problem of noise pulses and selectivity should be kept in mind when deciding what to expect from the noise limiter in the 75A-4 or any receiver having highly selective tuned circuits.

Procedure for modification of receivers below serial number 2716.

1. Move all the shields and ground connections from pin 3 of S3 to pin 1 of S4 as shown in Figure 1.

2. Connect pin 9 of S3 to pin 1 of S4.

3. Add 6.8 K ohm resistor, R118, CPN 745 1387 00, from pin 3 of S3 to pin 1 of S4.

4. Mount tie point, CPN 306 0001 00, on mounting screw of C94 as shown in Figure 2.

5. Move the 100K ohm resistor, R116, and the DA9256 wire on TS-1-1 to TS-4-3.

6. Move the DAS96 wire on TS-3-3 to TS-1-1.

7. Add a 47K ohm resistor, R117, CPN 745 1422 00, between TS-3-3 and TS-1-1.

8. Remove the ground end of C97 from ground and tie it to TS-4-2.

9. Add a 0.1 mf capacitor, C146, CPN 931 0299 00, between TS-1-1 and TS-4-2.

10. Add the DA935 wire from TS-4-2 to pin 3 of S3 on the front panel.

11. Add the 510 mmf capacitor, C147, CPN 912 0545 00, from pin 5 of V12 to ground, TS-2-2.

12. Add the 510 mmf capacitor, C148, CPN 912 0545 00, from pin 2 of V12 to ground, TS-3-2.

Additional parts required: Modification kit 542 0850 00

Qty	Description	Circuit Symbol	Collins Part Number
1	Tie point	TS-4	306 0001 00
1	Resistor, 6.8K, $\frac{1}{2}$ watt	R118	745 1387 00
1	Resistor, 47K, $\frac{1}{4}$ watt	R117	745 1422 00
2	Capacitor, 510 mmf	C147, C148	912 0545 00
1	Capacitor, 0.1 mf	C146	931 0299 00

TO OBTAIN PARTS:

For modification parts, price quotations (minimum order charge is $15.00), and availability contact Collins Radio Company, Service Parts Department, Cedar Rapids, Iowa 52406. All parts orders must specify the Collins modification kit number, or part numbers, quantity required, and reference this service bulletin.

FIGURE 1

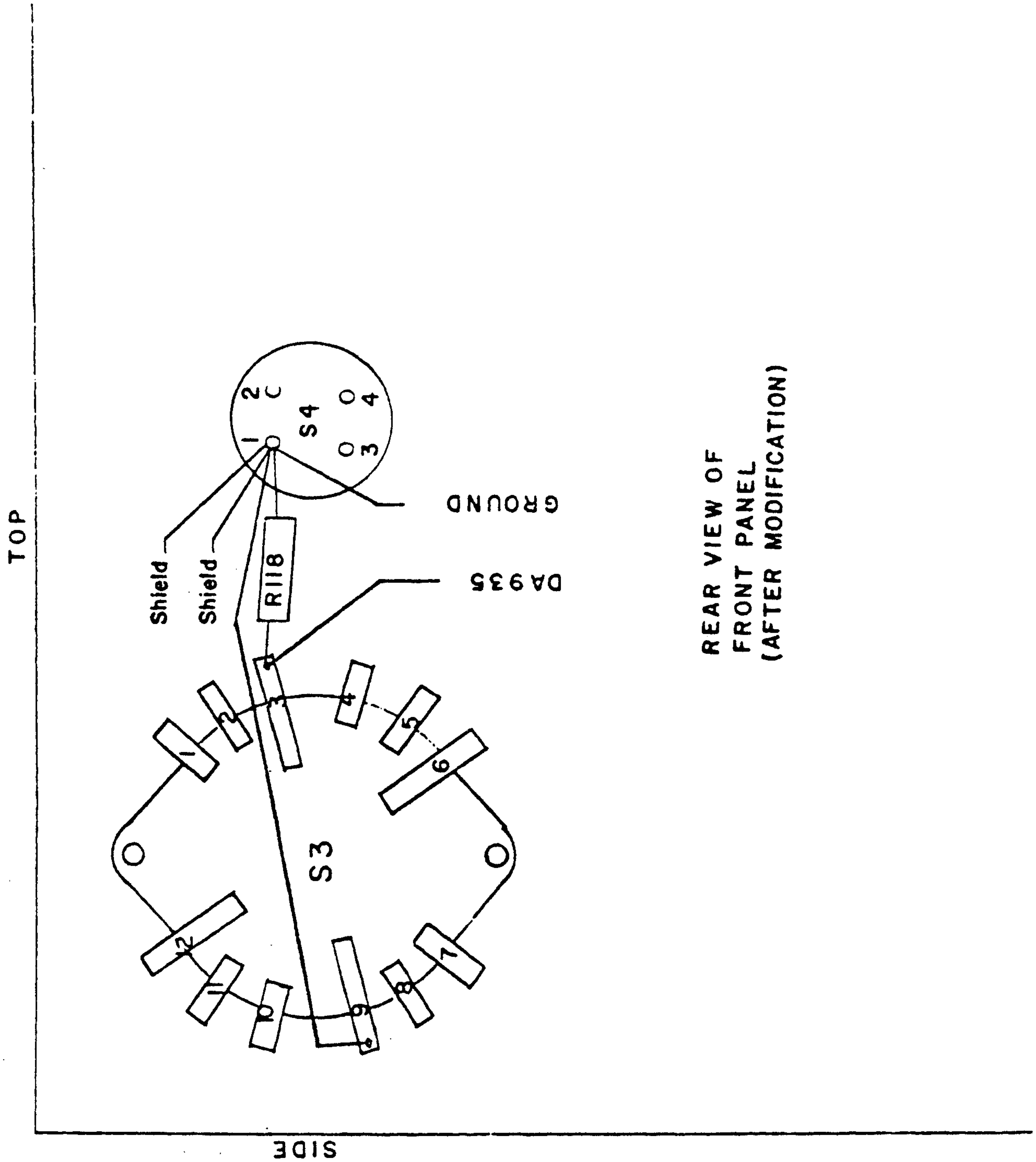
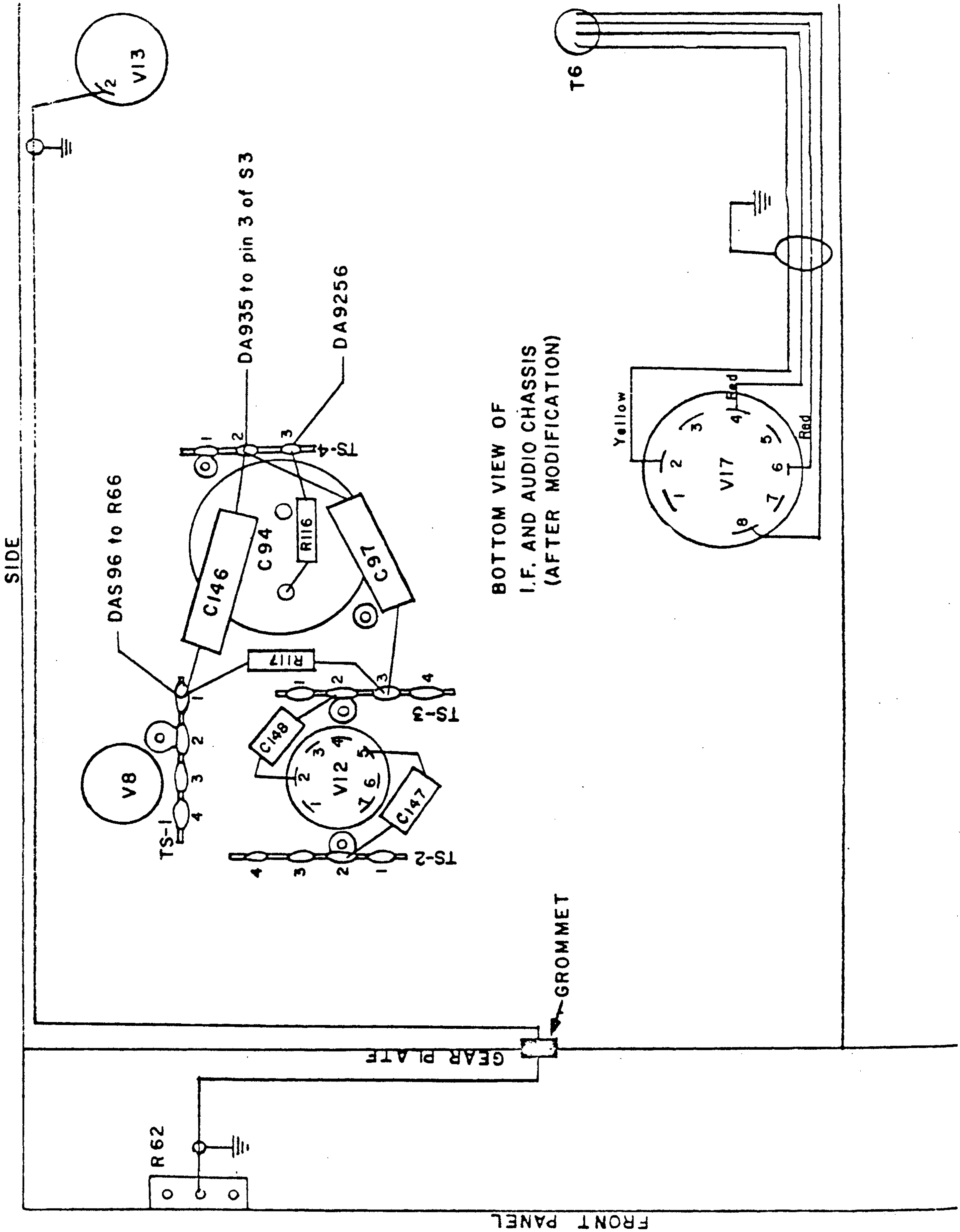

TOP
SIDE
S4
1
2
C
3
4
GROUND
Shield
Shield
R118
DA935
S3
REAR VIEW OF
FRONT PANEL
(AFTER MODIFICATION)

FIGURE 2


SIDE
V13
T6
DAS 96 to R66
DA935 to pin 3 of S3
DA9256
C146
C94
R116
C97
R117
TS-1
TS-2
TS-3
TS-4
V8
V12
C148
C147
BOTTOM VIEW OF
I.F. AND AUDIO CHASSIS
(AFTER MODIFICATION)
Yellow
Red
Red
V17
GROMMET
GEAR PLATE
R62
FRONT PANEL