

SANYO

MODEL
AFT-3N

All-transistor Radio *Service Manual*



SPECIFICATIONS

FREQUENCY RANGE

FM 87-108 Mc/s
AM 535-1605 Kc/s

INTERMEDIATE FREQUENCY

FM 10.7 Mc/s
AM 455 Kc/s

SENSITIVITY

FM 10 μ V at 30 db quieting 75 ohms input
AM Radiation sensitivity 50 μ V/m for 10mW output

S/N RATIO

FM 55 db at 1mV input

DISTORTION

FM less than 4 % at 1mV input

OUTPUT POWER

Undistorted 280 mW
Maximum 400 mW

POWER SOURCE

6 volts: 4 size C flashlight batteries
Current drain FM no signal no output 18 mA
Maximum output 110 mA

TRANSISTORS

2SA240	FM	RF Amplifier
2SA240B2	FM	Converter
2SA93	FM	1st IF Amplifier
	AM	Converter

2SA93

FM 2nd IF Amplifier

2SA93

AM 1st IF Amplifier

FM 3rd IF Amplifier

AM 2nd IF Amplifier

2SB54

FM Impedance Matching

2SB54

AF Amplifier

2SB189 x 2

Power Amplifier

DIODES & THERMISTOR

1N60

AM AVC

1N60

FM Limiter

1N60 x 2

FM Detector

1N60

AM Detector & AVC

1N60

FM AVC

D91A

Thermistor; Current Regulator

SPEAKER

3 $\frac{1}{2}$ " Permanent dynamic speaker
Voice coil impedance 7 ohms

ANTENNA

Ferrite core bar antenna for AM
Built-in telescoping antenna for FM

DIMENSIONS

Width	9 $\frac{1}{2}$ "
Depth	2 $\frac{1}{2}$ "
Height	5"

WEIGHT

Approximately 3 pounds (with batteries)

SANYO ELECTRIC CO., LTD.

PART NO.	STOCK NO.	DESCRIPTION
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FIXED RESISTORS

R 1	2.2K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 2	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 3	560 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 4	100 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 5	1K ohms $\pm 5\%$ $\frac{1}{4}$ W Carbon film
R 6	2.2K ohms $\pm 3\%$ $\frac{1}{4}$ W Carbon film
R 7	6.2K ohms $\pm 3\%$ $\frac{1}{4}$ W Carbon film
R 8	100 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 9	4.7K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 10	27K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 11	1.5K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 12	1.8K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 13	39K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 14	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 15	3.3K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 16	330 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 17	220 ohms $\pm 20\%$ $\frac{1}{2}$ W Mold
R 18	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 19	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 20	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 21	10K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 22	220K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 23	220 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 24	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 25	18K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 26	1K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 27	4.7 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 28	1K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 29	100 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 30	68 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 31	1.3K ohms $\pm 5\%$ $\frac{1}{4}$ W Carbon film
R 32	2.2 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 33	100 ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 34	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 35	56K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 36	22K ohms $\pm 10\%$ $\frac{1}{4}$ W Mold
R 37	27K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 38	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold
R 39	5.6K ohms $\pm 10\%$ $\frac{1}{2}$ W Mold

PART NO.	STOCK NO.	DESCRIPTION
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CAPACITOR & RESISTOR PACKED

	R-CXC004	1K ohms $\pm 10\%$ 1/10W 0.04 μ F $\pm 80-20\%$ 25V
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CABINET

	R-31392 a	Cabinet
	R-31393	Back
	R-32192	Dial plate (polystyrol)
	R-28031L	Frame metal
	R-26361	Front panel
	R-26364	FM/AM 9 TRANSISTOR panel
	R-35157	Handle
	R-23481	" SANYO " mark
	R-34051	Volume control knob
	R-33289	Drum
	R-33263	Tuning control knob

MISCELLANEOUS

	R-26363	" Tuning " plate
	R-24031b	Screw to fix back cover
	R-15096a	Spring for drum
	R-23482	Pointer
	R-23367	Positive terminal
	R-S8279	Negative terminal
	R-S2040	Earphone jack
	R-S2025a	AM antenna jack
	R-S3100	FM antenna terminal board
	R-23348	Spade lug
	R-S8278	Back screen
	R-S1143	Collapsible rod antenna

ALIGNMENT PROCEDURES

In aligning this combined AM/FM receiver, the two alignment processes are substantially independent of each other but it should be mentioned that alignment of AM section should be proceeded with that of FM because of avoiding unfavourable result which may be caused by interference between closely located parts.

Alignment of FM section

Many excellent instruments are used to speed up and increase the efficiency of the process of aligning FM set as well as to obtain the superior performance of our product.

Equipment required:

- An oscilloscope
- A sweep marker generator for FM IF alignment or a sweep type signal generator and a marker generator
- A tuning wand
- A network (as in Fig. 2)
- A FM signal generator covering 87 to 108 Mc/s
- A vacuum tube voltmeter

The method of connecting the apparatus for visual alignment of FM receiver is illustrated in Fig. 1. It is common that, in order to assist with the alignment, a small "pip" can be produced on the displayed curve by injecting a marker signal from an accurately calibrated signal generator to the receiver together with a sweep generator signal.

In this illustrated case we use the sweep marker generator. It has a built-in marker generator which produces a signal of 10.7Mc/s fixed and 10.7Mc/s signal with the side marker signal of $\pm 200\text{Kc/s}$ separated from 10.7Mc/s.

The marker signal with its output variable is injected in the sweep generator to the signal which has passed through the receiver and is picked up from the receiver.

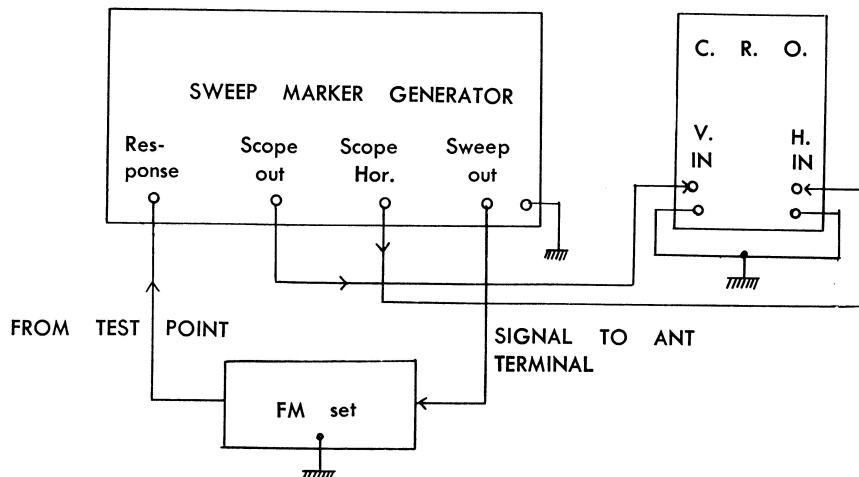


Fig. 1

FM IF alignment

1. Connect the "hot" lead from the sweep marker generator through $0.01\mu\text{F}$ to FM antenna terminal and the ground lead to the earth terminal. Before this connection the dial should be set at the position of both no interference signal and as-large-as-possible capacitance of the tuning gang.
2. Connect the "Response from Receiver" cable from the generator in series with a network illustrated in Fig. 2 between test point "A" and "E" (earth). (Refer to main parts location and Fig. 3)
3. Adjust the output of the sweep marker generator to a level just high enough to provide a sufficient scope pattern.
4. Adjust T1, T2, T4 and the primary of T6, viewing a scope pattern, to obtain a response curve indicated as Fig. 5.
5. This adjustment is accomplished as following. First tune T4 and primary of T5 for maximum gain, simultaneously keeping the trace precisely centered on the 10.7Mc/s. Next adjust T1 and T2 to make the on-10.7Mc/s-centered pattern symmetrically-shaped and to obtain maximum gain with simultaneous intent to locate the markers of plus and minus 200Kc/s symmetrically as to the 10.7Mc/s. This will complete the FM IF alignment.
6. In above procedures, the output of the sweep marker generator should be reduced to a level just high enough to provide a usable scope pattern in proportion to the gain increase of IF stages. It is necessary to avoid limiting effect for aiming at precise alignment.

FM discriminator alignment

1. Connect the sweep marker generator in the same way as IF alignment.
2. Connect the "Response from Receiver" cable directly to test point "B" (see Fig. 3), without the network of Fig. 2, and lower lead to earth.
3. Detune the secondary of detector transformer by turning its core at maximum anticlockwise position and then you will have the scope pattern which is similar to the pattern seen in IF alignment except the reverse polarity.

4. This pattern should be symmetrical as to 10.7Mc/s marker. If not symmetrical, readjust the primary of T5 a little bit for complete symmetry. When slight turn of the slug is not effective, realignment of IF stages should be necessary. Also check the symmetry of $\pm 200\text{Kc/s}$ markers.
5. If the symmetric curve obtained, tune the slug of the secondary for having the 10.7Mc/s marker located at the 0 level and obtaining "S"-shaped curve illustrated in Fig. 9.
6. Adjustment of detector stage is successfully completed if scope pattern as illustrated in Fig. 9, in which "S" curve and location of side markers of $\pm 200\text{Kc/s}$ are symmetrical viewed from the reference point of symmetry (10.7Mc/s), is obtained. In the case of unsymmetrical pattern, turn the slug of primary of T5 a little bit to make it symmetric. When slight turn of the slug is not effective, realignment of IF stages is required.

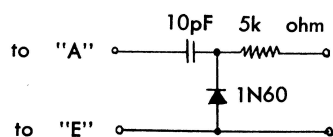


Fig. 2

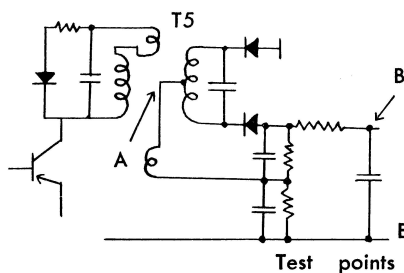


Fig. 3

Alignment for FM RF stages

Preparation for alignment

FM signal generator is used instead of a sweep marker generator and connected as in Fig. 4.

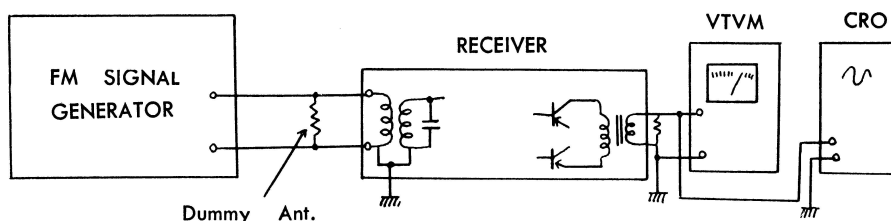


Fig. 4

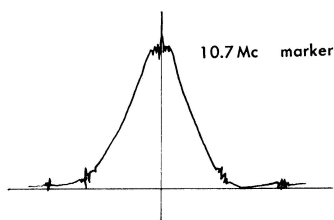
Use FM signal modulated at 400cps with deviation of $\pm 22.5\text{Kc/s}$, and the output cable from the generator should be terminated with dummy antenna, impedance of which depends on signal generator used. The signal developed across the dummy is applied to receiver.

Output power of receiver is consumed with dummy load equivalent to speaker.

A desirable voltage range of vacuum tube volt meter is 1.5V because alignment conducted at a level of 50mW output power.

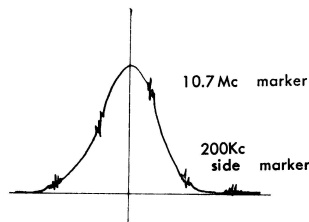
FM RF alignment

1. Set the volume control at position of medium volume and set the tuner dial at 90Mc/s.
2. Set the generator frequency at 90Mc/s. Adjust oscillator coil for maximum deflection of meter. If it is difficult to obtain optimum gain, slight adjustment of oscillator trimmer (Ct2) is paid.
3. Set the generator frequency and tuner dial at 106Mc/s, obtain maximum gain by adjustment of Osc. trimmer.
4. Again set tuner dial at 90Mc/s and vary the generator frequency around 90Mc/s to be tuned by the tuner. When the tuning generator frequency is not 90Mc/s, adjust Osc. coil to obtain optimum gain at 90Mc/s of the generator frequency.
5. Set tuner dial at 106Mc/s and vary the generator frequency around 106Mc/s to be tuned by the tuner. When the tuning generator frequency is not 106Mc/s, adjust Ct2 to obtain optimum gain at 106Mc/s of generator frequency.
6. Repeat the entire process until no further adjustment is required at either point of the dial.



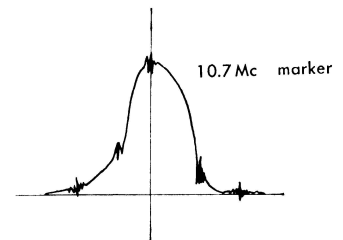
SCOPE PATTERN OF COMPLETE IF CHARACTERISTICS
Curve is symmetric. 10.7 Mc marker locates at center of curve. Symmetrical location of side markers.

Fig. 5



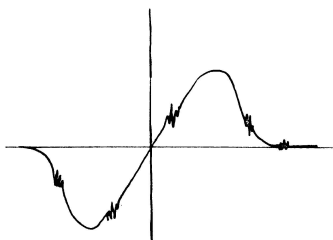
UNCOMPLETE IF CHARACTERISTIC PATTERN
Symmetric curve, but off-centered 10.7 Mc marker.

Fig. 6



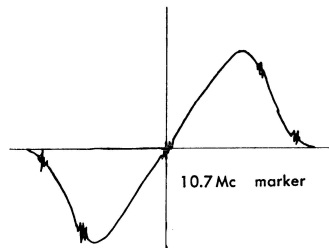
UNCOMPLETE IF CHARACTERISTIC SCOPE PATTERN
10.7 Mc marker on center of curve, but unsymmetric curve.

Fig. 7



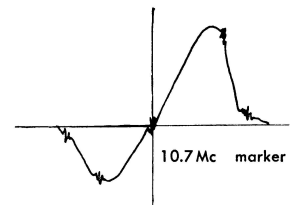
UNCOMPLETE DETECTOR
CHARACTERISTIC SCOPE PATTERN
Symmetric curve, but bad location of markers.

Fig. 8



COMPLETE DETECTOR CHARACTERISTIC SCOPE
PATTERN
"S" curve and location of markers is symmetric in reference to 10.7 Mc marker.

Fig. 9



UNCOMPLETE DETECTOR
CHARACTERISTIC SCOPE PATTERN
"S" curve is unsymmetric viewed from reference point of 10.7 Mc marker.

Fig. 10

Tracking

1. Set the generator frequency at 106Mc/s and make the tuner tune in the 106Mc/s signal.
2. Adjust trimmer Ct1 for maximum gain. If the gain increases with approaching tuning wand to coil L3 for checking the tracking, readjust the trimmer for maximum meter reading.
3. Set the generator at 90Mc/s and make the tuner tune in the 90Mc/s signal. Adjust the slug of oscillator coil L3 for maximum gain. If the gain increases at the time of approaching tuning wand to L3, readjust the slug of L3.
4. Arrange in the manner as step 1 and approach the wand to L3. If the gain increases readjust the slug.
5. Arrange in the manner as step 3 and approach the wand to L3. If the gain increases readjust the trimmer.
6. Repeat steps 4 and 5 until no further adjustment is required at either end of the dial.

During this entire procedures, make certain that the generator output is kept to a level just high enough to produce usable meter deflection.

Overall checking of alignments

After adjustment of RF and IF stages finished, apply the signal of 94Mc/s to the antenna terminal of tuner and have the receiver tuned in the signal accurately. Observe the waveform of output signal across the dummy load with 30 db level of the signal modulated at 400 cps, 75 Kc deviation applied to the antenna. If the precise waveform of 400 cps sine wave appeared on the scope, adjustment will be proved to be successfully completed, and if heavily distorted waveform readjustment of IF and RF stages should be required. When the frequency of the signal generator is changed at same distance away from the center tuning frequency of the tuner on either side, waveform and degree of distortion of both cases should be similar to each other. If not, readjustment of IF stages and discriminator should be necessary.

AM sections alignment procedures

Apply volt-meter across the voice coil. Volume control should be at maximum position. Output of signal generator should be no higher than necessary to obtain output reading in order to avoid AVC function.

STEP	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	RADIO DIAL SETTING	ADJUST FOR MAXIMUM OUTPUT
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IF ALIGNMENT

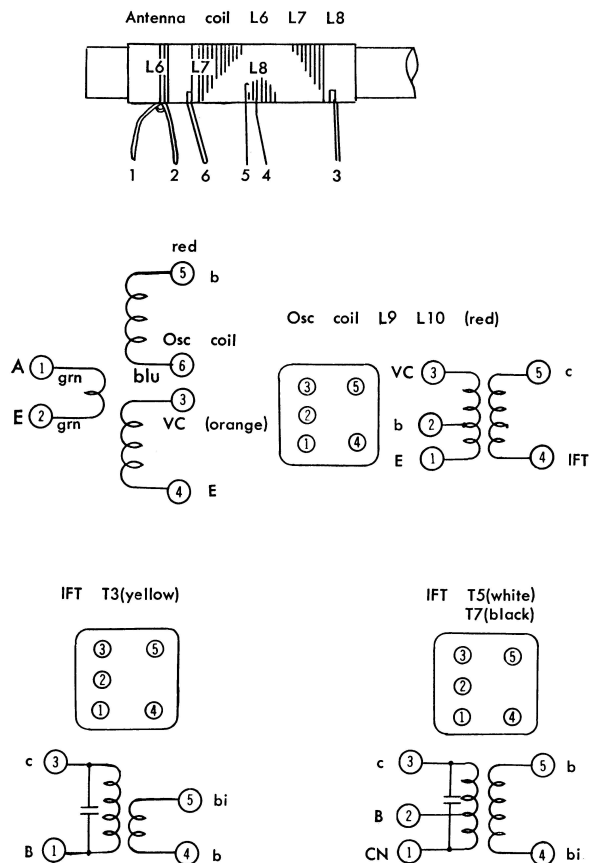
1	High side through 0.1mF capacitor to antenna stator lug on tuning gang. Low side to chassis.	455 Kc	540 Kc	IF transformer T7 T5 T3
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BROADCAST RF ALIGNMENT

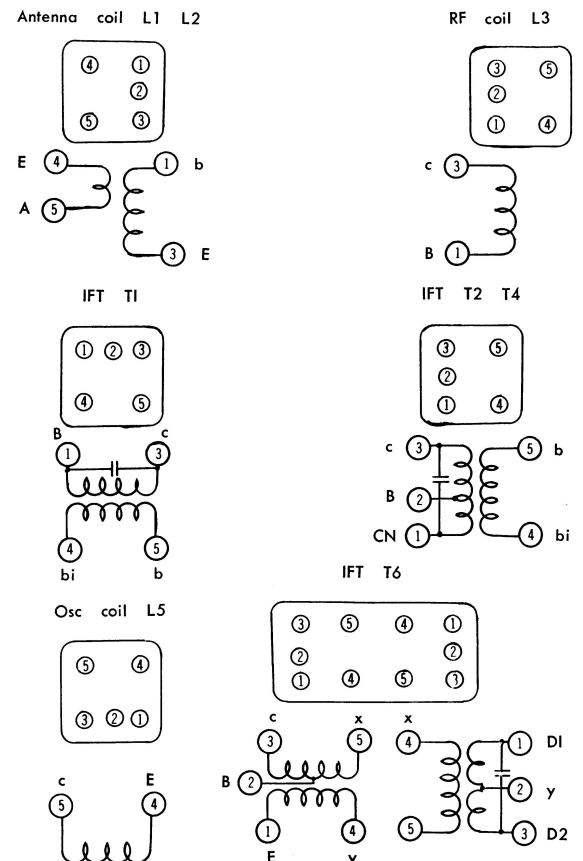
2	Fashion loop of several turns of wire and radiate signal into loop antenna.	540 Kc	540 Kc	Osc. coil L10
3		1600 Kc	1600 Kc	Osc. trimmer Ct 4
4		Repeat steps 2 and 3.		
5		600 Kc	600 Kc	Ant. coil L8
6		1400 Kc	1400 Kc	Ant. trimmer Ct 3
7		Repeat steps 5 and 6.		

MAIN PARTS TERMINAL IDENTIFICATIONS

1. AM

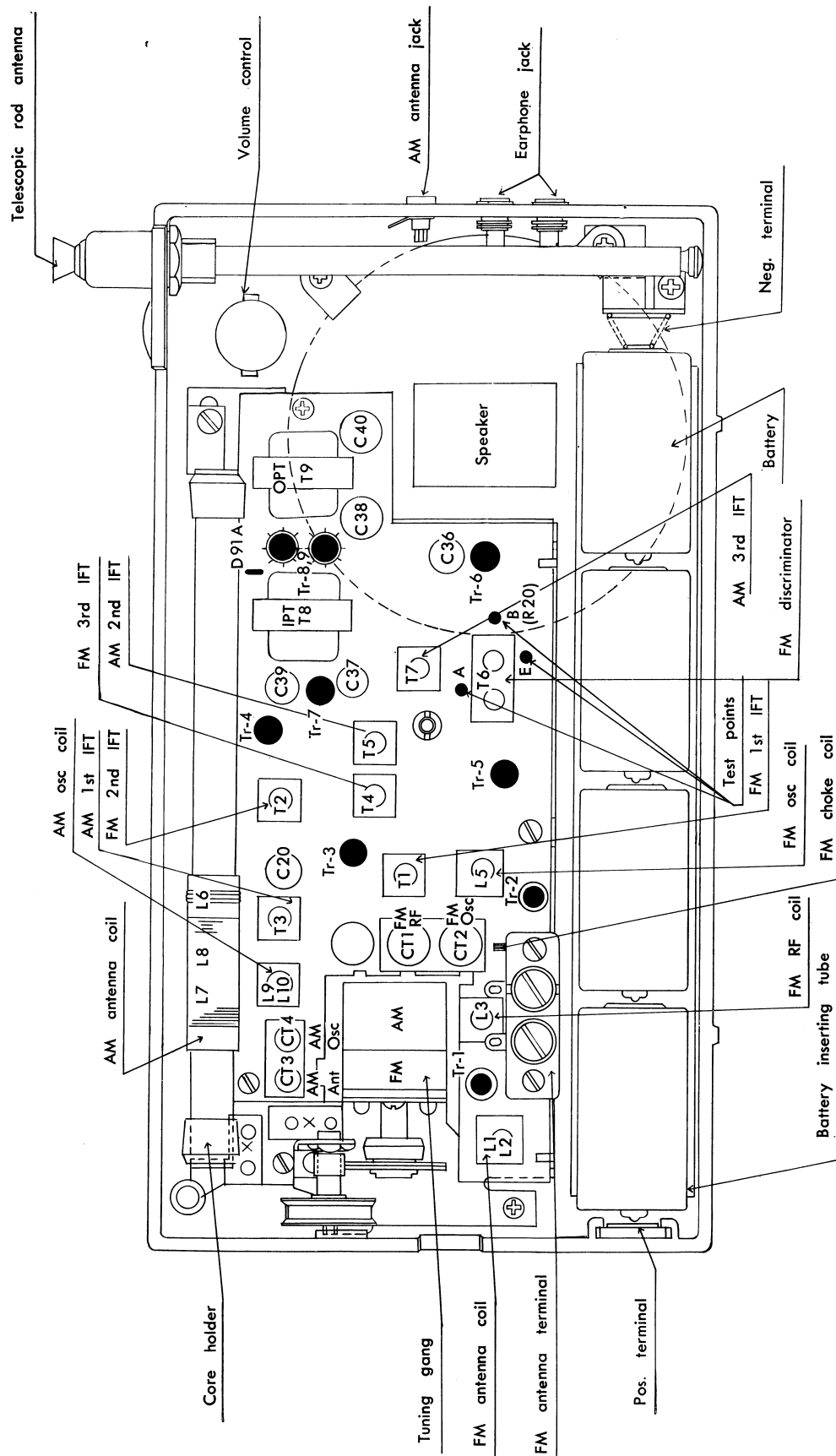


2. FM

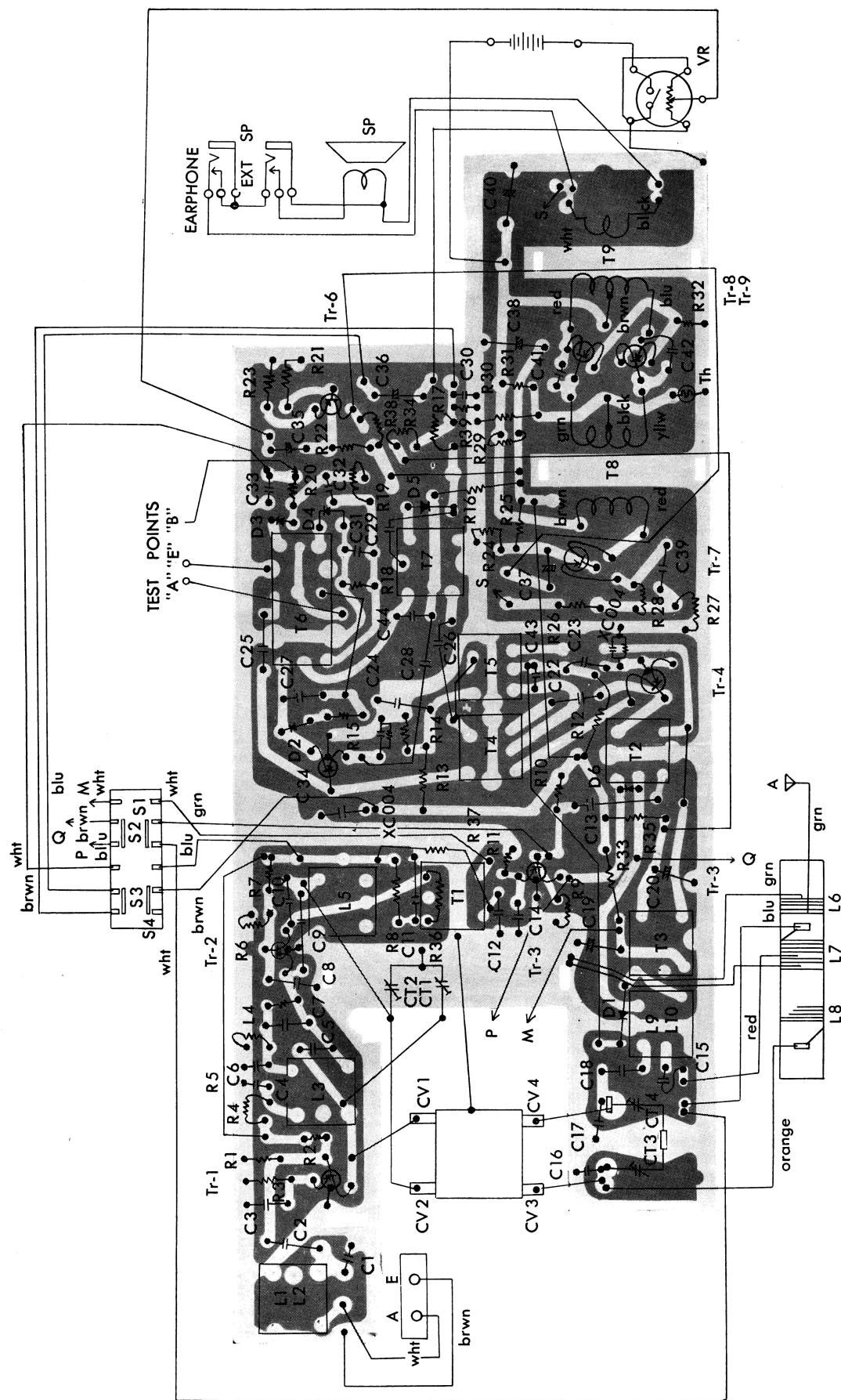


Service hints

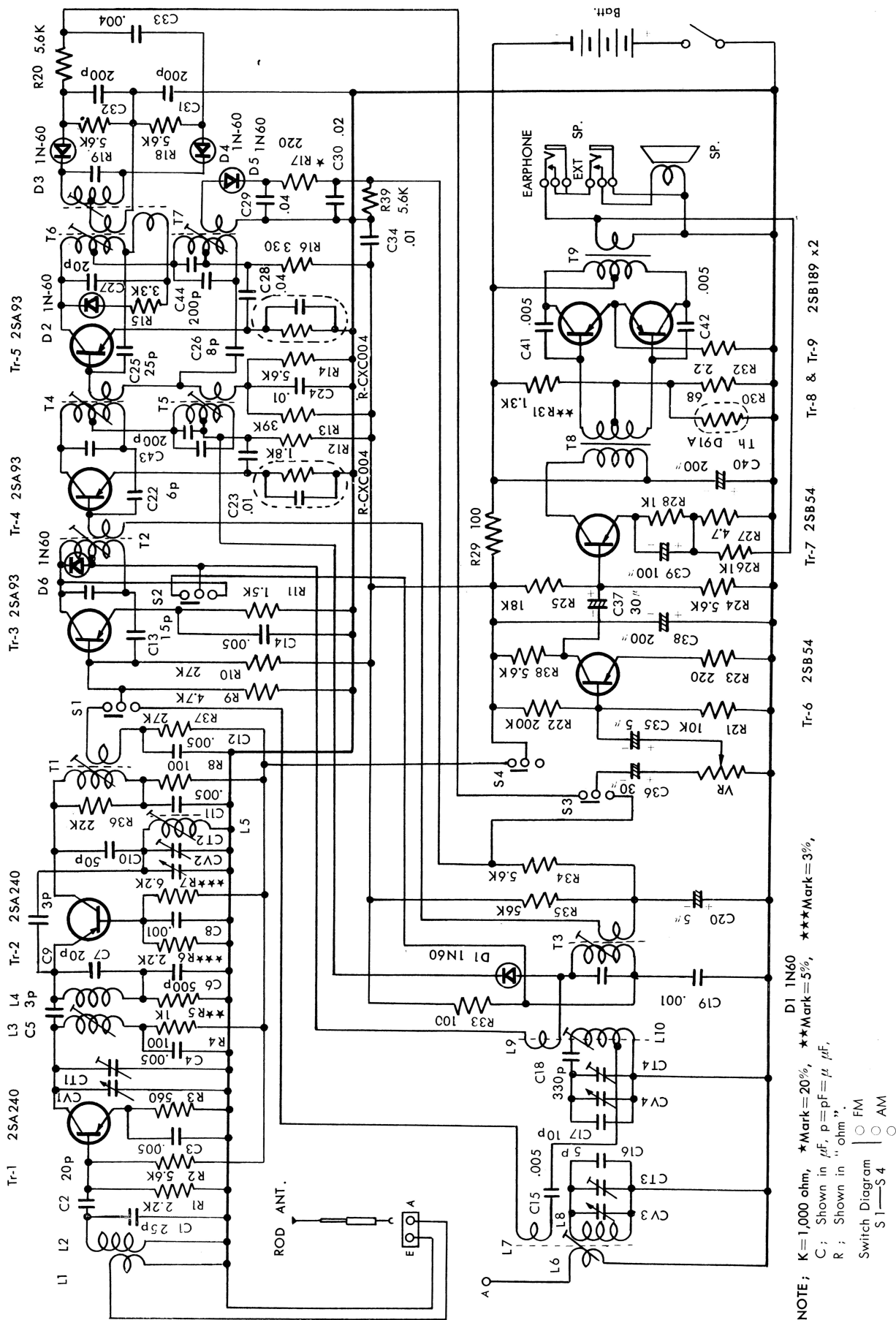
1. When the radio receiver does not function, check batteries first. If the voltage of these is lower than 80%, replace these with new ones.
2. With reference to the transistor used in this set, note that the "base" is the signal input terminal (corresponding to signal grid of tubes) and the "collector" is the signal output terminal (corresponding to plate of tubes), and the "emitter" is the common terminal (corresponding to cathode of tubes).
3. Accordingly, defects can be traced in exactly the same way as in the case of a tube radio, using the signal generator.
4. High side of the signal generator shall be connected through a capacitor, so that the bias voltage will not be affected.
5. In order to protect transistors when tracing defects, avoid the followings:
 - i) Wrong polarity.
 - ii) Shortcircuiting with any conductor such as a screw driver.
 - iii) Checking circuit continuity with the receiver on.
 - iv) To use a soldering iron for long time when replacing a transistor or component parts.
6. Output circuit is of B class push-pull system. Note that the input signal increases the collector current in the B class push-pull system.
7. A. V. C. properly functions if emitter voltage of the Tr-4 (AM 1st IF Ampl. stage) goes down as input signal increases.
8. Local oscillator properly functions if distinct "click" is heard when lug of Osc. side is touched with a conductor such as a screw driver and, if only slight noise is heard, oscillation does not function.
9. Use Vacuum Tube Volt-Meter or high resistance Volt-Meter (1V/10kilo ohms or any value in the vicinity) to measure the voltage of transistor.
10. Readjustment shall be made when converter stage or IF amplifier stage is repaired with new parts, especially transistor.
11. Note that the unbalanced power Ampl. stage causes poor tone.
12. It happens to occur that an optimum "S" curve of discriminator can not be obtained with remarkable adjustment paid, although a symmetrical IF response curve centered on 10.7 Mc is obtained. As its cause, unbalanced characteristic between two detector diodes is to blame.
13. As external case of IF transformer in and cap of transistor in FM section are grounded to earth, caution must be paid not to shortcircuit them with other parts.



INTER-PARTS WIRING ILLUSTRATION



CIRCUIT DIAGRAM



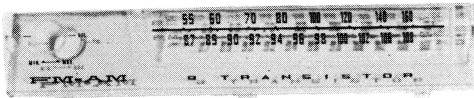
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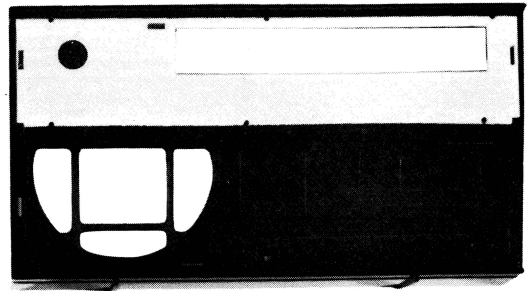
(R-35157)



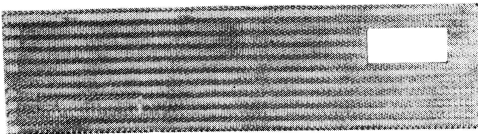
(R-32192)



(R-31392a)



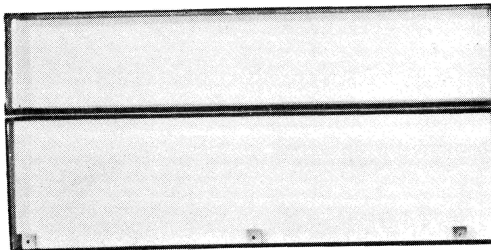
(R-26361)



(R-31393)



(R-28031L)



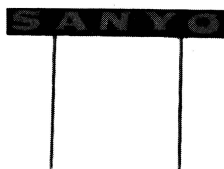
(R-26364)



(R-26363)



(R-23481)



(R-S3100)



(R-S2040) (R-S2025a)



(R-23348) (R-15096a)



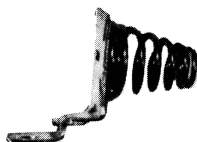
(R-23482)



(R-34051)



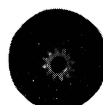
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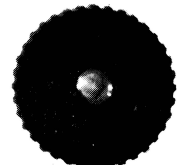
(R-23367)



(R-33289)



(R-33263)



PART NO.	STOCK NO.	DESCRIPTION
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TRANSISTORS

Tr 1	2SA240	FM RF Amplifier
Tr 2	2SA240B2	FM Converter
Tr 3	2SA93	FM 1st IF Amplifier AM Converter
Tr 4	2SA93	FM 2nd IF Amplifier AM 1st IF Amplifier
Tr 5	2SA93	FM 3rd IF Amplifier AM 2nd IF Amplifier
Tr 6	2SB54	FM Impedance Matching
Tr 7	2SB54	AF Amplifier
Tr 8	2SB189	Power Amplifier
Tr 9	2SB189	Power Amplifier

DIODES & THERMISTOR

D 1	1N-60	AM AVC
D 2	1N-60	FM Limiter
D 3	1N-60	FM Detector
D 4	1N-60	FM Detector
D 5	1N-60	AM Detector & AVC
D 6	1N-60	FM AVC
T h	D91A	Thermistor: Current Regulator

COILS

L 1, 2	R-W2078	FM Antenna coil
L 3	R-W4013	FM RF coil
L 4	R-W1014	FM Choke coil
L 5	R-W8048	FM Oscillator coil
L 6, 7, 8	R-S8500	AM Antenna coil
L 9, 10	R-W8025	AM Oscillator coil

TRANSFORMERS

T 1	R-W5T076	FM IF Transformer 1st stage
T 2, 4	R-W5T075	FM IF Transformer 2nd & 3rd stages
T 3	R-W5T083	AM 1st IF Transformer
T 5	R-W5T084	AM 2nd IF Transformer
T 6	R-W5W004	FM IF Transformer Det. stage
T 7	R-W5T073	AM 3rd IF Transformer
T 8	R-W6105	Input Transformer
T 9	R-W6106①	Output Transformer

CONTROLS

S1 ~ 4	R-S4164	Slide Switch
V C	R-C1061a	Variable Capacitor
Ct 1, 2	R-C0023	2-block Trimmer
Ct 3, 4	R-C0013	2-block Trimmer
V R	R-R11618a	Volume Control

PART NO.	STOCK NO.	DESCRIPTION
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ELECTROLYTIC CAPACITORS

C 20	5 μ F	6 V
C 35	5 μ F	6 V
C 36	30 μ F	6 V
C 37	30 μ F	6 V
C 38	200 μ F	10 V
C 39	100 μ F	6 V
C 40	200 μ F	10 V

LOUDSPEAKER

S P	R-S6191	3 $\frac{1}{2}$ " Speaker
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FIXED CAPACITORS

C 1	25pF \pm 10%	250V Ceramic
C 2	20pF \pm 10%	250V Ceramic
C 3	0.005 μ F \pm 80-20%	25V Ceramic
C 4	0.005 μ F \pm 80-20%	25V Ceramic
C 5	3pF \pm 0.5pF	500V Ceramic
C 6	500pF \pm 20%	50V Ceramic
C 7	20pF \pm 10%	250V Ceramic
C 8	0.001pF \pm 80-20%	25V Ceramic
C 9	3pF \pm 0.5pF	500V Ceramic
C 10	50pF \pm 10%	500V Ceramic
C 11	0.005 μ F \pm 80-20%	25V Ceramic
C 12	0.005 μ F \pm 80-20%	25V Ceramic
C 13	15pF \pm 10%	25V Ceramic
C 14	0.005 μ F \pm 30-20%	50V Mylar
C 15	0.005 μ F \pm 30-20%	50V Mylar
C 16	5pF \pm 0.5pF	25V Ceramic
C 17	10pF \pm 1pF	25V Ceramic
C 18	330pF \pm 10%	125V Styrol
C 19	0.001 μ F \pm 30-20%	50V Mylar
C 22	6pF \pm 0.5pF	25V Ceramic
C 23	0.01 μ F \pm 80-20%	25V Ceramic
C 24	0.01 μ F \pm 80-20%	25V Ceramic
C 25	20pF \pm 10%	250V Ceramic
C 26	8pF \pm 0.5pF	25V Ceramic
C 27	20pF \pm 10%	250V Ceramic
C 28	0.04 μ F \pm 80-20%	25V Ceramic
C 29	0.04 μ F \pm 30-20%	50V Mylar
C 30	0.02 μ F \pm 30-20%	50V Mylar
C 31	200pF \pm 20%	500V Ceramic
C 32	200pF \pm 20%	500V Ceramic
C 33	0.004 μ F \pm 30-20%	50V Mylar
C 34	0.01 μ F \pm 80-20%	25V Ceramic
C 41	0.005 μ F \pm 30-20%	50V Mylar
C 42	0.005 μ F \pm 30-20%	50V Mylar
C 43	200pF \pm 20%	500V Ceramic
C 44	200pF \pm 20%	500V Ceramic