

FM-STEREO MODULATOR

MODEL AFM-2

DESCRIPTION

Model AFM-2 is designed to provide an f.m. signal in the 88 to 108 megacycle range, suitable for transport over a tv distribution system at an r.f. carrier frequency specified by the system operator.*

Audio, or the standard 10.7 mc intermediate frequency signal from an f.m. tuner, can be used as a source of modulation. With an audio input applied, Model AFM-2 is used as a generator of f.m. signals; with a 10.7 mc i.f. input, the AFM-2 acts as a converter for the received f.m. signals and for the multiplex sidebands in stereo f.m. broadcasts. In either

operating mode, the output of the modulator is compatible with existing f.m. receiving equipment..

Model AFM-2 circuitry incorporates automatic frequency control, a crystal-controlled r.f. oscillator, an i.f. amplifier, a modulation level control, and dual 75-ohm matched outputs. A chassis-mounted meter continuously monitors the audio modulation level or permits reading the relative r.f. output.. The built-in power supply is line-regulated. A number of test points are provided to facilitate maintenance. The unit is designed for 19" standard rack mounting.

*Check Lf. carrier frequency on package against your order and requirements.

SPECIFICATIONS

<p>FREQUENCY RANGE INPUT</p> <p>OUTPUT</p> <p>MINIMUM INPUT LEVEL AUDIO</p> <p>10.7 MC I.F.</p> <p>MINIMUM OUTPUT AT FULL GAIN</p> <p>MAXIMUM NOISE AND HUM AT FULL GAIN</p> <p>MAXIMUM AUDIO DISTORTION AT FULL GAIN</p> <p>GAIN CONTROL RANGE</p> <p>INPUT IMPEDANCE</p> <p>OUTPUT IMPEDANCE</p> <p>MAXIMUM INSERTION LOSS</p> <p>POWER REQUIREMENT</p> <p>OVERALL DIMENSIONS</p> <p>NET WEIGHT</p>	<p>Audio: 50 to 15,000cps.</p> <p>10.7mc I.F.: Bandwidth from Lf. to r.f. 0.35mc at 3 db down. 88 to 108 mc.</p> <p>60 millivolts at 200cps for 75 kc deviation, ± 2.5 db max. 50 millivolts for full output..</p> <p>55 dbj" dual output..</p> <p>At least 40 db below full gain.</p> <p>1.5%</p> <p>14 db.</p> <p>100,000ohms, audio; 75 ohms, 10.7 mc Lf.</p> <p>75 ohms at max. VSWR of 1.25: 1; both outputs.</p> <p>0.2 db to within 1.0 mc of f.m. channel; 0.5 db to within next channel spaced 0.5 mc.</p> <p>100 to 130volts, cps, 40 watts.</p> <p>19 1/2" L, 5 1/2" H, 6-31/32" W.</p> <p>13 lbs.</p>
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(1) 0 dbj = 1000 microvolts across 75 ohms.

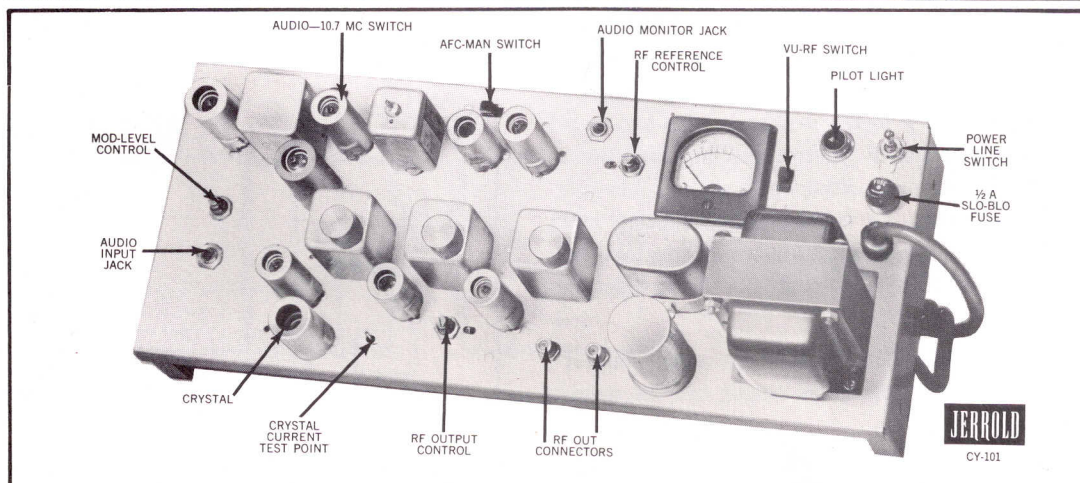


Fig. 1—Model AFM-2 Top View of Chassis

CHART OF CONTROLS AND CONNECTIONS

NAME AND POSITION	SCHEMATIC DESIGNATION	TYPE	FUNCTION
ON-OFF	S4	SPST Toggle switch.	Energizes and de-energizes unit.
AUDIO-IN	J1	Phone Jack.	Permits connection of audio source (f.m. tuner, microphone, etc.).
10.7 MC IN	J2	F-61A chassis fitting.	Permits connection of 10.7 mc Lt. from f.m. tuner.
AUDIO MONITOR	J3	Phone Jack.	Permits connection of speaker or headset for monitoring purposes.
MOD LEVEL	R1	Potentiometer.	Controls audio input level.
AFC-MAN	S1	SPDT Slide switch.	Removes a.f.c. voltage to facilitate alignment.
AUDIO-10.7 MC	S2-A, B, C	3-PDT Slide switch.	Audio: unit generates f.m., with source connected to J1, 10.7 mc: unit acts as converter, with i.f. connected to J2.
VU RF	S3	SPDT Slide switch, spring loaded.	VU: meter reads a.f. level. RF: meter reads r.f. level, (normal position: VU).
XTAL CURRENT	TPI (C38)	Feed-thru capacitor.	Test point for checking r.f. oscillator crystal current.
RF OUT	J4,5	F-61A chassis fittings.	Matched dual output connections.
RF OUTPUT CONTROL	R31	Potentiometer.	Controls amplitude of signal passed to r.f. amplifier stage.
RF REF. CONTROL	R49	Potentiometer.	Permits setting of O-reference r.f. level on meter.

CIRCUIT DESCRIPTION

(Compare Dwg. 861-489)

The functional block diagram fig. 2 illustrates the signal flow in Model AFM-2. Basically, the circuitry consists of an audio section, an i.f. section, and an r.f. section.

The audio section is a single-stage amplifier employing tube VI-A. With an audio source connected to phone jack J1, the signal passes through a level control R1 and coupling capacitor C1 to the grid of VI-A. A pre-emphasis network, R4, R5 and C3, determines the response of the audio amplifier.

The output of the audio section is passed to a reactance modulator VI-B in the i.f. stage and frequency-modulates a 10.7 mc oscillator V2. Filter network L1 and C6 prevent the 10.7 mc oscillator voltage from appearing in the plate circuit of VI-A.

From the oscillator the signal passes through a discriminator stage employing transformer T2 and twin-diodes V3-A and B. The d.c. voltage developed across load resistors R14 and R15 is used as corrective voltage to the reactance tube and thus furnishes automatic frequency control for the oscillator. "AFC-MAN" switch S1 permits disconnecting the a.f.c. circuit, facilitating alignment. To isolate the monitoring and metering circuits from the a.f.c. circuitry, a cathode follower V4 is employed which is coupled through C14 to the discriminator stage.

De-emphasis network R23, C16, provide an audio output compatible with the input; the audio output can be monitored at phone jack J3.

For use as an f.m. converter, the Lt. signal from an f.m. tuner is inserted at J2 and coupled through C43 to the grid of V8.

The plate output of V8 is then coupled through C10 to the grid of V2 which now acts as an amplifier-limiter. Switch S2-A, Band C disables the a.f.c. and energizes the Lt. amplifier V8.

The r.f. section consists of a crystal-controlled oscillator V7, a mixer stage V6 and an r.f. amplifier V5. The mixer beats the r.f. from V7 and V2 to give an output frequency which is 10.7 mc below the second harmonic of the crystal frequency. Potentiometer R31 controls the amplitude of the signal passed to the r.f. amplifier by varying the plate and screen grid voltages on V6. The output of V6 is capacity-coupled by C25 to the grid of the r.f. amplifier V5. Finally, the l.c.-tuned output of V5 is capacity-coupled by C17 to dual output connectors J4 and J5.

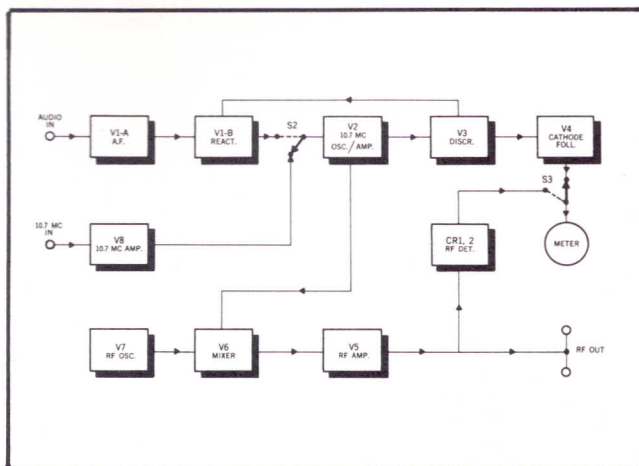


Fig. 2—Model AFM-2 Functional Block Diagram

INSTALLATION

Model AFM-2 is shipped with the following accessories:

- 4 slotted nickel-plated steel screws, for mounting the unit on a 19" standard relay rack.
- 1 phone plug, for mounting on cable connected to an audio source.
- 1 F-59A connector for mounting on coaxial cable connected to a 10.7mc l.f. source.*
- 1 F-59A connector for mounting on coaxial cable to be connected to one of the two r.f. outputs on AFM-2 chassis.
- 1 TR-75F 75-ohm terminating resistor for terminating an unused r.f. output on AFM-2 chassis.

The dual output is a matched 75-ohm transmission line. It can be used either:

1. so that the combined r.f. source can be looped through, or:
2. with one output on the AFM-2 chassis terminated by the TR-75F supplied, the other output constitutes a termination for the combined r.f. line.

Fig. 3 illustrates typical installations with Model AFM-2 connected to a tv distribution head-end. Naturally, Model AFM-2 is the perfect f.m. companion piece to a 12 tv-channel distribution system.

After the unit has been mounted and interconnected, follow the step-by-step initial set-up:

1. Where an audio input is applied to the unit, check for correct input level in accordance with specification; MOD. LEVEL potentiometer R1 permits making the necessary adjustment.
2. Where a 10.7 mc i.f. is inserted, check for input level as per specifications.

*See fig. 5 for tap-off on tuner.

3. To set the desired r.f. output level as a 0-reference on the VU-meter for future readings and gain control adjustments, connect a Model 704-B field strength meter through a 20-db pad to one of the r.f. outputs; holding VU-RF switch S3 in RF position, adjust RF REF CONTROL potentiometer R49 until 0-VU reference is read on the meter for the desired level shown on the field strength meter.
4. With switch S3 back in VU position, audio output is metered continuously; peak swings of the meter needle should come as close as possible to 0-VU reference; again use MOD. LEVEL control R1 to adjust for this condition.
5. Re-check 0-reference for r.f. output, with S3 in RF position.
6. With S3 back in VU position, the audio level set up under step 4 should cause a deviation of not more than ± 75 kc.

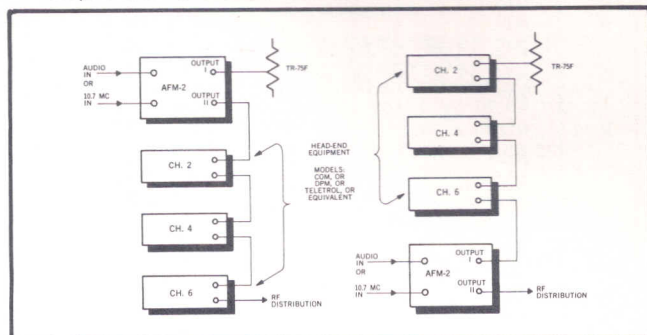


Fig. 3—Model AFM-2 in typical head-end installations

MAINTENANCE

No major maintenance is required except for occasional input and output checks. XTAL CURRENT test point TP1 is provided for checking the oscillator drive on the grid of tube V7. A VTVM with a 10 megohm impedance probe must be used for this measurement; the average voltage reading should be -2.5 V.

If a tube requires replacement, only a new and exactly equivalent type of a recognized brand should be substituted. After tube replacements, the unit may need some realignment. The following is a complete alignment procedure, together with replacement parts list and circuit schematic.

A. TEST EQUIPMENT REQUIRED:

- Sweep Frequency Generator, Jerrold Models 602, 7070, 900A, 900B.
- Signal Generator, capable of generating 10.7mc.
- Oscilloscope.
- Detector, Jerrold Model 0-86.
- Field Strength Meter, Jerrold Model 704-B.
- VTVM, with 10 megohm impedance.

B. ALIGNMENT OF DISCRIMINATOR

1. Switch S2 to 10.7 MC position.
2. Connect a 75-ohm resistor between pin 1 on tube V2 and ground.
3. Connect sweep generator to pin 1 on tube V2.
4. Couple in signal generator set to produce 10.7mc mark.
5. Connect oscilloscope to junction of R16 and C14.
6. Switch S1 to MAN position.
7. Adjust discriminator for the response shown in fig. 4, whereby the transformer primary (top of chassis) is to be adjusted for amplitudes A1 and A2 to be equal, and the secondary (bottom of chassis) is to be adjusted for the frequency curve crossing the base line at the 10.7 mc marker.
8. Remove 75-ohm resistor from pin 1 on V2 and ground.

C. ALIGNMENT OF 10.7 MC OSCILLATOR AND I.F. SECTION

1. Insert 10.7mc marker to RF input on 0-86.
2. Couple loosely to pin 5 of V2 and connect to RF OUTPUT on 0-86.
3. Connect SCOPE output of 0-86 to oscilloscope.
4. Switch S1 to MAN position, S2 to AUDIO position.
5. Adjust L3 for zero beat between local 10.7mc oscillator and 10.7mc output of signal generator.
6. Switch S1 to AFC position.

7. Adjust secondary (bottom of chassis) of discriminator transformer again for 10.7 mc zero beat.
Note: For all further adjustments, S1 is to remain in AFC position.

D. ALIGNMENT OF RF SECTION

1. Connect VTVM to test point TP1.
2. Adjust L9 for maximum grid drive on V7; VTVM should read approx. -2.5 volts, whereby it should be made certain that the oscillator is tuned on low slope.
3. Connect 704-B to one of the RF outputs, terminate the other by a TR-75F terminating resistor.
4. Adjust C34, C27 and C20 for maximum output on 704-B, with C34 peak at the high capacity end.
Note A: The r.f. indicated on the 704-B equals twice the xtal frequency less 10.7, in megacycles/sec.
(r.f. = 2 fxtal - 10.7)
Note B: On each adjustment choose the peak of highest amplitude.
5. Turn RF OUTPUT CONTROL R31 fully clockwise; reading on 704-B should be more than 55 dbj.
6. Turn RF OUTPUT CONTROL R31 fully counter-clockwise; the difference between the reading under step 6 and that under step 7 should be less than 40 dbj.

E. 10.7 I.F. INPUT CHECK

1. Feed a signal of at least 25,000 microvolts into 10.7 MC IN connector J2.
2. Switch S2 to 10.7 MC position.
3. Output should be a minimum of 55 dbj.

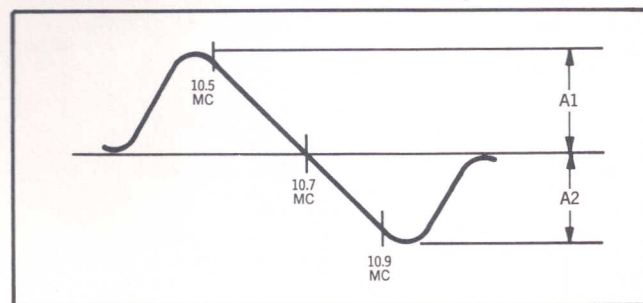
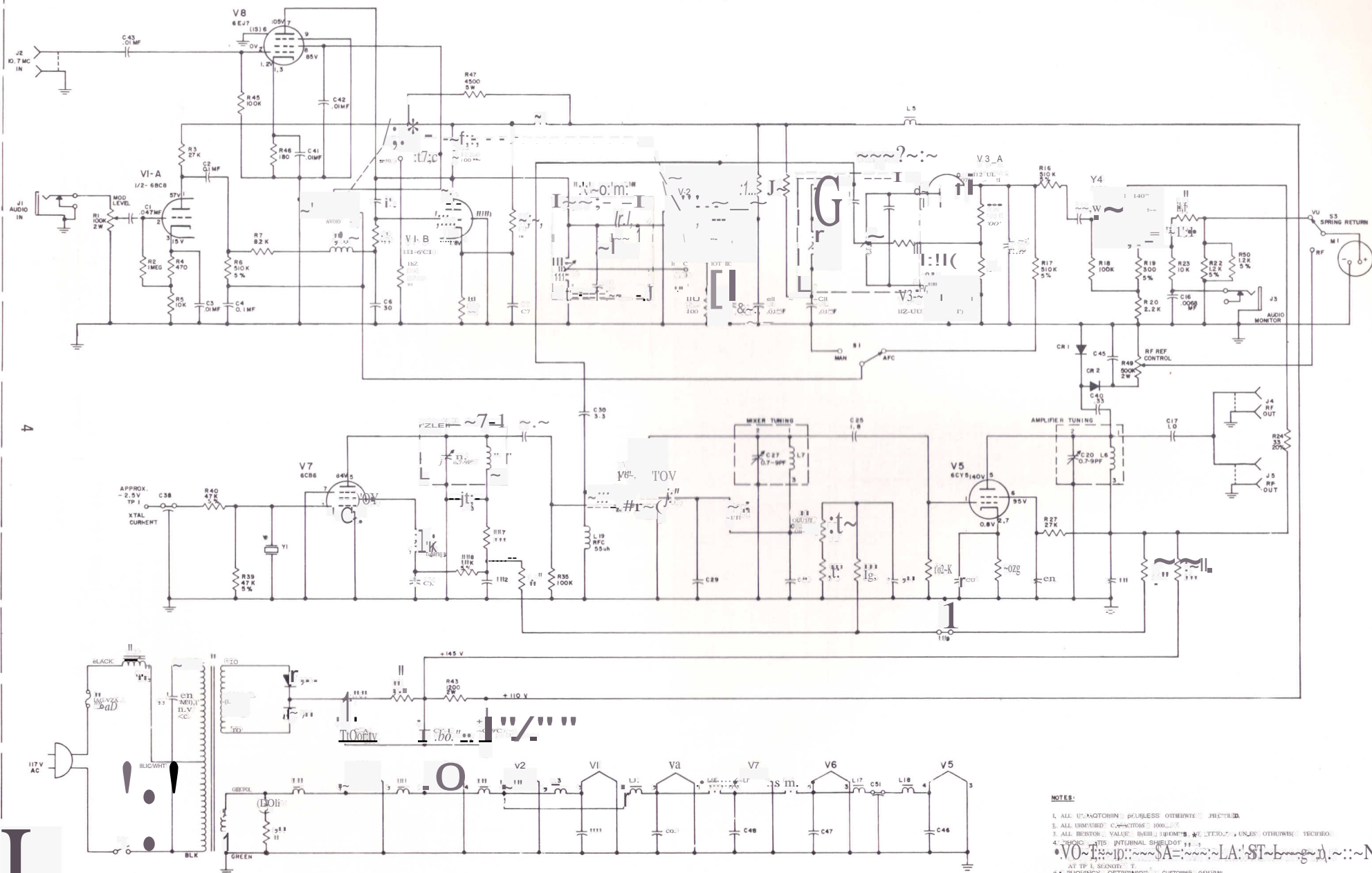


Fig. 4—Alignment of Discriminator Response

SCHEMATIC
FM STEREO MODULATOR
MODE.L AFM-2



- NOTES:**
1. ALL UNLABLED COMPONENTS ARE AS SHOWN.
 2. ALL UNLABLED CAPACITORS ARE 50% TOLERANCE.
 3. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
 4. TUBES ARE INTERNAL SHIELDING.
 5. VOICING DETUNING CUSTOMER OPTION.
 6. FREQUENCY DETUNING CUSTOMER OPTION.
 7. FOR MECHANICAL AT 50°C USE A 5% A WITH 10 OHM INPUT IMPEDANCE.

11-89-1

REPLACEMENT PARTS LIST

ITEM	CIRCUIT DESIGNATION	QTY.	DESCRIPTION	JERROLD PART NO.
CAPACITORS (C21, 28, 35, 37 not used)				
1	C1,14	2	0.047 mf. 400 V	125-001
2	C2,4	2	0.1 mf. 400 V	125-003
3	C3	1	0.01 mf. 400 V	125-013
4	C5	.1	2.2 mmf. ± 0.25 mmf. 500 V	121-005
5	C6	1	30 mmf. $\pm 2\%$, 500 V	121-019
6	C7, 8, 18, 22, 23, 24, 26, 29, 32, 33,36,45 thru 50	17-	1000 μ mmf. $\pm 10\%$, 500-600 V	123-115
7	C9	1	20 mmf. $\pm 2\%$, 500 V	121-014
8	C10	1	25 mmf. $\pm 10\%$, 500-600 V	123-101
9	C11, 12, 41 thru 44	6	0.01 mf. 500 V	124-031
10	C13	1	50 mmf. $\pm 10\%$, 600 V	123-122
11	C15	1	1.0 mf. 200 V	125-019
12	C16	1	6800 mmf. $\pm 10\%$, 400 V	125-025
13	C17,31	2	1.0 mmf. ± 0.25 mmf. 500 V	121-003
14	C19, 38, 51	3	1000 mmf. feed-thru	129-200
15	C20, 27, 34	3	h.f. trimmer, HFT-58	821-216
16	C25	1	1.8 mmf. ± 0.5 mmf. 500 V	121-039
17	C30	1	3.3 mmf. ± 0.25 mmf. 500 V	121-006
18	C39, A, 8, C	1	100-80-20 mf. 250-200-200 V, triple electrolytic	127-900
19	C40	1	0.33 mmf. $\pm 10\%$	122-027
20	C52	1	4 mf.	120-104
COILS				
21	L1	1	5.6 uh, r.f. choke	157-017
22	L2	1	100 uh, r.f. choke	157-014
23	L3	1	10.7 mc oscillator tuning coil	Part of 8156-186
24	L4, 5, 10 thru 18	11	bead chokes	109-103
25	L6, 7, 8	3	amplifier, freq. doubler and mixer tuning coils	Part of 8156-187
26	L9	1	r.f. oscillator tuning coil	Part of 8156-189
27	L19	1	55 uh, r.f. choke	157-034
28	L20	1	318 mh, a.c. choke	143-121
CONNECTORS				
29	J1, J3	2	phone jacks	185-100
30	J2, 4, 5	3	coaxial chassis fittings, type F-61A	C821-155
31	PI	1	6' line cord set	
CRYSTAL				
32	Y1	1	frequency-determined	139-109
DIODES				
33	CR1,2	2	K3A, 75 ma, 5 V, silicon	139-102
34	CR3,4	2	CER71-ST, 750 ma, 600 V, silicon	137-708
FUSE				
35	F1	1	0.5 a, 125 vac, S10-810	101-335
PILOT LIGHT				
36	DS1	1	47, 6-8 v, 150 ma	102-002

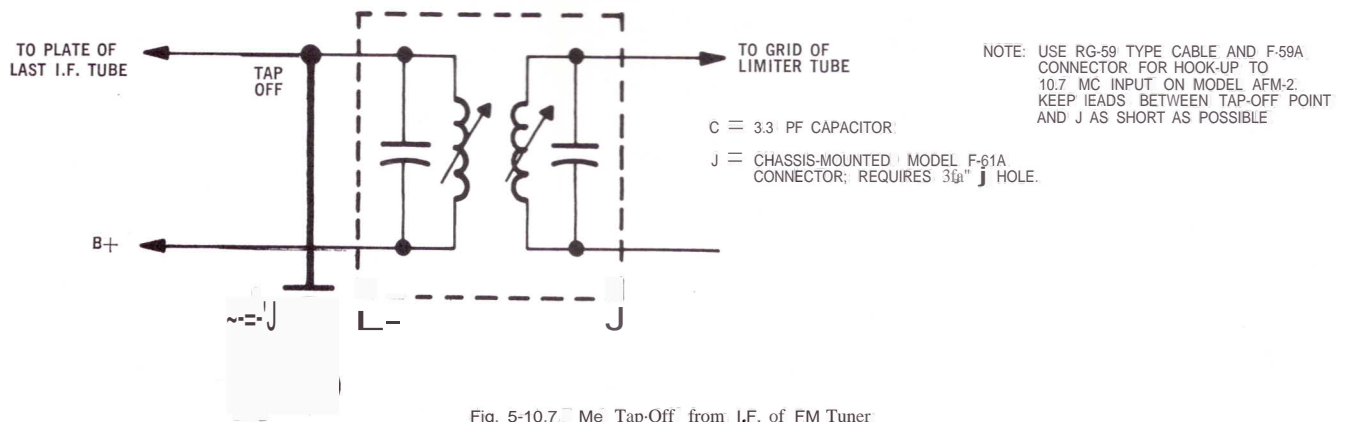


Fig. 5-10.7. Me Tap-Off from I.F. of FM Tuner

REPLACEMENT PARTS LIST

ITEM	CIRCUIT DESIGNATION	QTY.	DESCRIPTION	JERROLD PART NO.
RESISTORS (R34 not used)				
37	R1	1	100 k, 2 w, potentiometer	118-022
38	R2	1	1 megohm, $\pm 10\%$, $\frac{1}{2}$ w	112-740
39	R3, 27	2	27 k, $\pm 10\%$, $\frac{1}{2}$ w	112-542
40	R4,8	2	470 ohms, $\pm 10\%$, $\frac{1}{2}$ w	112-320
41	R5, 23, 37	3	10 k, $\pm 10\%$, $\frac{1}{2}$ w	112-488
42	R6, 16, 17	3	510 k, $\pm 5\%$, $\frac{1}{2}$ w	112-704
43	R7	1	8.2 k, $\pm 10\%$, $\frac{1}{2}$ w	112-479
44	R9	1	240 ohms, $\pm 5\%$, $\frac{1}{2}$ w	112-284
45	R10	1	33 k, $\pm 10\%$, $\frac{1}{2}$ w	112-552
46	R11	1	22 k, $\pm 10\%$, $\frac{1}{2}$ w	112-530
47	R12, 13, 24, 25, 26, 30	6	33 ohms, $\pm 20\%$, $\frac{1}{2}$ w	112-176
48	R14, 15, 18, 29, 35, 45	6	100 k, $\pm 10\%$, $\frac{1}{2}$ w	112-614
49	R19	1	300 ohms, $\pm 5\%$, $\frac{1}{2}$ w	112-293
50	R20	1	2.2 k, $\pm 10\%$, $\frac{1}{2}$ w	112-404
51	R21	1	510 ohms, $\pm 5\%$, $\frac{1}{2}$ w	112-326
52	R22,50	2	1.2 k, $\pm 5\%$, $\frac{1}{2}$ w	112-371
53	R28,48	2	100 ohms, $\pm 10\%$, $\frac{1}{2}$ w	112-236
54	R31	1	50 k, 2 w, potentiometer	118-024
55	R32	1	2 k, $\pm 5\%$, $\frac{1}{2}$ w	112-398
56	R33	1	15 k, $\pm 10\%$, $\frac{1}{2}$ w	112-509
57	R36	1	1 k, $\pm 10\%$, $\frac{1}{2}$ w	112-362
58	R39, 39, 40	3	47 k, $\pm 5\%$, $\frac{1}{2}$ w	112-569
59	R41	1	750 ohms, $\pm 10\%$, $\frac{1}{2}$ w, w.w.	113-052
60	R42	1	2.7 k, $\pm 10\%$, $\frac{1}{2}$ w	112-416
61	R43	1	1.2 k, $\pm 10\%$, $\frac{1}{2}$ w	112-376
62	R44	1	18 ohms, $\pm 10\%$, $\frac{1}{2}$ w	112-143
63	R46	1	180 ohms, $\pm 10\%$, $\frac{1}{2}$ w	112-269
64	R47	1	4.5 k, $\pm 10\%$, $\frac{1}{2}$ w, w.w.	113-058
65	R49	1	500 k, 2 w, potentiometer	118-030
SWITCHES				
66	S1	1	SPOT slide switch	162-002
67	S2-A, B, C	1	3POT slide switch	162-017
68	S3	1	SPOT slide switch, spring-return	162-012
69	S4	1	SPST toggle switch	162-001
TRANSFORMERS				
70	T1	1	line transformer	0141-155
71	T2	1	10.7 mc discriminator transformer assy.	142-101
TUBES				
72	V1	1	6BC8, twin triode	131-310
73	V2	1	6AV6, pentode	131-308
74	V3	1	6AL5, twin diode	131-303
75	V4	1	6AB4, triode	131-299
76	V5	1	6CY5, tetrode	131-316
77	V6	1	6AS6, pentode	131-307
78	V7	1	6CB6, pentode	131-313
79	V8	1	6EJ7, pentode	131-340

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