RADIO SERVICE INSTRUCTION



MA2F FM STEREO ADAPTER

SERVICE AND TEST PROCEDURES

The service and test information outlined in this manual is to enable the MA-2F stereo adaptor to be serviced and repaired in the field with common test equipment found in most service shops.

Balance and phase adjustment methods are outlined that may be accomplished by listening to the loudspeaker output. These adjustments are performed very accurately with a small amount of practice and ear training.

The alignment and service procedures included herein are as follows:

1. Balance and phase adjustment methods.

TEST EQUIPMENT REQUIRED FOR SERVICING

Audio Signal Generator Audio Vacuum Tube Voltmeter Oscilloscope - equivalent to GE ST2A Voltohmeter

BALANCE AND PHASE ADJUSTMENT METHODS

For proper operation of the General Electric FM Stereo adaptor two adjustments may be necessary during servicing or after installation. (1) The L+R and L-R signals may require balancing to produce correct stereo separation. (2) The phasing of the 38KC subcarrier to the L-R side bands may have to be adjusted to eliminate distortion in the detected L-R signal.

The FM stereo adaptor is correctly aligned at the factory to provide proper stereo separation and no distortion in the detection of the L-R side bands. Before any adjustment of the FM stereo adaptor is attempted make sure the adaptor is properly connected to the FM tuner. The amplifier speaker system must be properly phased, and the stereo amplifier adjusted for the stereo reproduction.

FM Stereo balance is performed by adjustment of control R4 which adjusts the amount of L+R information added to the L-R information to result in separate left and right channel signals. The stereo effect will be degraded by improper adjustment of R4.

The sub-carrier phase adjustment is made by adjusting the 19KC (L1) and 38KC (L2) filter coils. The coils are peaked, then rocked for proper phase relationship to L-R side bands. If distortion is noticed on the FM stereo function the phase adjustment should be performed. DO NOT TOUCH THE OTHER COILS (L3, L4, L5). Their adjustment is not critical, so if they are out of adjustment they have shorted or open turns and must be replaced.

BALANCE ADJUSTMENT PROCEDURES

Three alternate methods for adjustment of balance control (R-4) are outlined in the

following as Methods A,B, and C. Method A will be the most practical for field service but will require a small amount of ear training and practice. The aural effect of the widening and narrowing of stereo separation by rotating control R-4 is easily grasped when standing in the exact center of a stereo speaker system separated at a distance of approximately 6 feet. The stereo system must be in phase. These system checks are easily made by listening to the speaker system from a monaural program. When the system is properly adjusted for monaural the sound will come from the exact center of the two speakers. Do this before attempting to practice the procedure outlined in Method A. After experiencing the aural effects of the adjustment of R4 when directly in front of the speaker system, the technician will be able to duplicate the adjustment from the back of a console phonograph.

METHOD "A" - This is an aural method by listening to a stereo amplifier speaker system with the signal source being an FM stereo station broadcasting a stereo program.

- Properly tune in the FM station on the FM tuner and adjust the stereo amplifier for proper stereo operation.
- Rotate control R-4 in the adaptor to its complete <u>clockwise</u> position. (Use a plastic screwdriver). This places the arm of the control at ground or at OFF position. No L+R information can now pass the control and appear in the amplifier output. Only L-R information will be heard.
- 3. Stand as close to the speakers as is possible and <u>midway</u> between the right and left speakers. The sound of the L-R signal only will produce a "phantom" effect where the sound seems to float around the room, and come from a point to your rear. (Note: if severe distortion is noticed at this point, perform the 19KC and 38KC filter adjustment
- 4. Rotate control R4 in the adaptor <u>counter clockwise</u> until the sound appears to come from the right and left speakers and just loses the "phantom" effect, THIS IS THE CORRECT ADJUSTMENT. The control will have been turned approximately one-quarter turn counter-clockwise.
- 5. As the control R-4 is rotated farther counter-clockwise the sound will proportionately appear to come from a point closer to the center of the two speakers, causing a complete loss of stereo separation. (All of the sound will appear to come from a point between right and left speaker). If the control R-4 is not turned up enough for proper stereo separation the stereo separation will be extreme and annoying with a "hole" in the center between the two speakers.

(See Separation Effect Sketch)

SEPARATION EFFECT OF R-4 ADJUSTMENT

METHOD "B" - Adjustment with use of audio signal generator, and audio vacuum tube voltmeter.

- Connect a 1-volt rms 1000 cycle audio signal to the input jack of the adaptor.
- Adjust R-4 in the adaptor to produce 1 volt rms at the left output jack.
- (a) With this method it has to be assumed that we have unity gain in L-R channel. A $\frac{+}{2}$ 3 db unity gain spec.is listed for the adaptor.

(Note: If the output signal is observed with an oscilloscope the wave may appear distorted. This is due to the fact that there is no 19KC pilot and hence no 38KC carrier to unclamp the detector diodes. (D1-D2).

METHOD "C" - (Most accurate method)

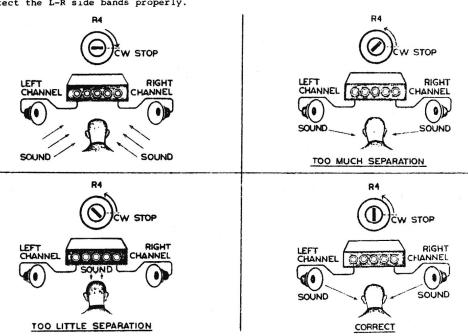
By tuning in an FM Stereo Station broadcasting program or <u>test signal</u> transmitted on one channel (left or right)only.

- Properly tune in the FM station on the FM tuner.
- Rotate the stereo amplifier balance control to the stereo channel (left or right) that is opposite from the channel being broadcast. Listen or measure the voltage at the speaker being used.
- Adjust R-4 in the adaptor for minimum signal.

SUB-CARRIER PHASE ADJUSTMENT PROCEDURE

This is an aural method to adjust L-l and L-2 coils for proper sub-carrier phase to detect the L-R side bands properly.

- Properly tune in an FM station broadcasting an FM stereo program.
- Be sure the FM Stereo Adaptor is connected properly to the FM tuner,
- Rotate the control R-4 in the adaptor to its complete clockwise position. This is to remove all L+R information; therefore, the output that is heard from the speakers will be only detected L-R information.
- Rotate the balance control on the stereo amplifier completely to the left(or right).
- Listen carefully to the output of the left (or right) speaker. Adjust the 19KC filter coil (L-1) for maximum output and minimum distortion (maximum clarity). (Use a plastic hex adjusting tool for the coils).
- 6. Also adjust the 38KC filter coil (L-2) for maximum output and minimum distortion while carefully listening to the speaker output. Note, if the coils are so far out of adjustment that no improvement can be noticed, perform the "Procedure for pre-peaking pilot and sub-carrier."
- 7. Repeat Steps 5 and 6 (Gentle rocking of the coil slug may make the undistorted adjustment point more obvious). It may not be possible to eliminate <u>all</u> distortion since some may be coming from the station, and this is most obvious on the L-R channel.
- Rotate the balance control of the stereo amplifier to center (or balance) position.
- Adjust the FM stereo adaptor balance control R-4 by one of the methods outlined under I.



SYNCHRONOUS OSCILLATOR MODIFICATION

In later production adaptors the 19KC pilot signal doubler circuit was changed from a frequency doubler to a synchronous oscillator circuit. Units incorporating this change are identified by Code A-42 rubber stamped on the chassis apron. This circuit change provides better 19KC pilot signal filtering in the adaptor, which results in a minimum amount of L-R high frequency distortion from stations transmitting with extended high frequency response.

Component part differences for the synchronous oscillator version are as follows;

	Changed to .22 mfd.	
Capacitor C7 1.0 mfd. (or two 0.5 mfd.)		
19KC Coil L2 Cat.# EA36X10	Cat.# EA35X6	
Resistor R9 1000 ohms ½ watt	820 ohms ½ watt	
Capacitor C20 1000 mmfd.	47 mmfd. 10% 500V	

Capacitor C22 (Not used) 47 mmfd. N2200
Added VIB grid to B minus

N.P.O.

Decreasing the value of capacitor C7 to .22 mfd. in the grid circuit of VIB increases the feedback and causes this stage to oscillate. The oscillator will operate in the vicinity of 1900 as determined by the resonant circuit consisting of the variable inductance of the coil L1 and the fixed capacity of capacitors C3, C22 and C7.

The 19KC pilot signal is fed to the oscillator coil L1 to synchronize the oscillator to the pilot signal. Synchronization takes place when coil L1 is tuned to resonate at 19KC. A ± 180 degree phase shift of generated 38KC is obtained by tuning L1 within the limits of synchronization. The correct phase angle of the pilot signal is accomplished by tuning L1 to approximately center of the in-sync area.

The plate load of VIB consists of a parallel resonant circuit formed by L2 and C17 which is tuned to the second harmonic of the pilot signal or 38KC. This resonant circuit reconstructs the original subcarrier. The adjustment of L2 changes the amplitude of subcarrier and is not used to vary subcarrier phase. The correct subcarrier phase is established by tuning oscillator coil L1.

The amplitude of regenerated subcarrier is held constant by the use of an oscillator. Therefore the strength of incoming pilot signal is used only to synchronize the 19KC oscillator and stabilize the generated subcarrier.

The 38KC subcarrier developed in the plate circuit of VIB is inserted to the junction of diodes D1 and D2 by capacitor C2O.

The value of capacitor C2O is reduced to 47 mmfd. since the subcarrier output is much greater by use of an oscillator. Capacitor C2O establishes the proper subcarrier level for insertion to the L-R sidebands

SERVICING THE SYNCHRONOUS OSCILLATOR VERSION

Adaptor alignment is possible by use of an FM Stereo broadcast signal as the test signal. Two adjustments may be necessary when servicing the adaptor in the field;

Subcarrier Adjustment
 Stereo Separation Adjustment

Procedures for these two adjustments are outlined in the following text.

SUBCARRIER ADJUSTMENT

The subcarrier adjustment is accomplished in two steps. Subcarrier phase is set aurally by adjustment of oscillator coil L1, and the regenerated 38KC subcarrier is peaked to maximum amplitude by adjustment of L2 with the use of a meter or scope.

SUBCARRIER PHASE ADJUSTMENT

This is an aural method to adjust oscillator coil L1 by receiving a transmitted FM Stereo signal.

- Properly tune in an FM station broadcasting an <u>FM</u> <u>Stereo Program.</u>
- 2. Be sure that the FM Stereo Adaptor is connected properly to the tuner and amplifier.
- 3. Rotate separation control R4 in the adaptor to its complete <u>clockwise</u> position. This will remove all L+R information, therefore the sound output heard from the speakers will be detected L-R information only. (ALTERNATIVE the center tap of R4 may be shorted to ground with a clip lead to preserve the control setting.)
- 4. Rotate the stereo amplifier balance control completely to the right (or left). Adjust tone controls for minimum Bass and maximum Treble.
- 5. Listen carefully to the sound output of the selected right (or left) speaker. If the oscillator is not adjusted to 19KC, a beat or squeal will be heard which overpowers the station program. If the oscillator is running at 19KC the program material will be distinct. One small area of the complete tuning range of Ll will produce 19KC. This area covers approximately 240 degrees of one slug rotation. The phase of the generated 38KC signal is shifted \$\frac{1}{2}\$ 180 degrees during this area of slug rotation. The proper setting for the slug of Ll is at the exact midpoint between the audible beat or squeal as described in the next step.
- 6. Use a plastic hex head adjusting tool. When rotating the tuning slug of coil L1 clockwise from the extreme counter-clockwise area where the beat or squeal is heard, the following successive signal changes will be noted a clear program peak, a null, a clear program peak (center), a null, a clear program peak and then into the clockwise area of beat or squeal. The correct phase setting is with the slug of L1 adjusted to the midpoint of the center peak of distinct program material.

ADJUSTMENT OF 38KC COIL - L2

After completing the subcarrier phase adjustment with coil L1, the 38KC filter coil L2 is peaked by the following procedure.

1. Apply a vacuum tube voltmeter or oscilloscope test probe to the plate (pin 6) of oscillator tube V1 (12AT This test point is accessible at the top of the printo board. Use a 470,000 ohm ½ watt resistor in series with the VTVM or scope probe and pin 6 for isolation. Adjust the slug of L2 to peak the 38KC response as observed on the VTVM or scope.

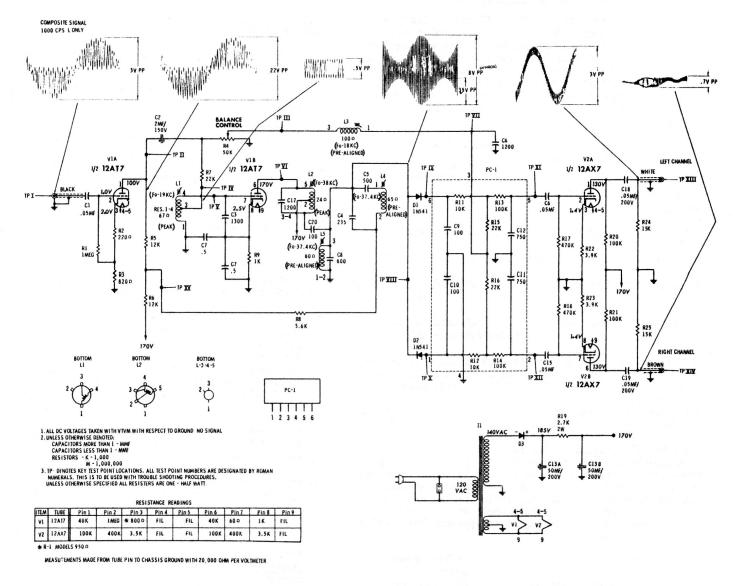
After this adjustment remove the VTVM or scope connections and repeat the 19KC phasing adjustment procedure as outlined in the preceeding text. Listen carefully for least high frequency distortion on loud passages of program while adjusting.

Repeat 38KC (L2 coil) peaking adjustment.

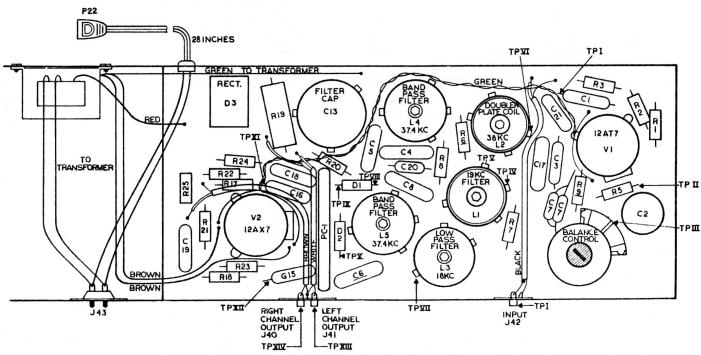
When the subcarrier phase and peaking adjustments are completed, the stereo separation control R4 is adjusted for optimum stereo separation.

STEREO SEPARATION (BALANCE) ADJUSTMENT

Stereo balance adjustments of the synchronous oscillator version are performed the same as with the doubler versio Follow the balance potentiometer (R4) adjustment procedures outlined on pages 1 and 2.



MA-2F FM STEREO ADAPTOR SCHEMATIC



FM STEREO OPERATION

For a more detailed explanation of the theory of operation, waveform analysis and signal tracing techniques refer to the Training Manual "FM Stereo Adaptor 1961-1962"

REPLACEMENT PARTS LIST

CAT. NO.	SYMBOL	DESCRIPTION	CAT. NO.	SYMBOL	DESCRIPTION
CAPACITORS			RECTIFIERS		
EA31X20 C2 Elec. 2 MFD @150V		EA16X1 D1,D2 Diode - IN541			
EA18X21	C2	MICA 1300 MMF ± 5% - 300V	EA57X5	D1, D2	Rectifier, Selenium
EA18X22	C4	MICA 235 MMF + 5% - 300V	ERSINS	22	Rectifier, Belefitum
EA18X23	C6,C17	MICA 1200 MMF + 5% - 300V	MISCELLANEOUS		
EA18X24	C7, C7	Ceramic .5 MFD - 3.0V	MISCELIANEOUS		
EA31X21	C13	Elec. 50/50 MFD @ 200V			I
PULLET	1 213	Elec. 30/30 MED @ 2000	EA88X15	Tl	Transformer, Power
EA33X11	C9,C10,C11	RC Couplate	EA8X38		Jack, Phono (Single Type)
LAJJAII	C12,R11,R12	no couplate	EA8X24		Jack, Phono (Dual Type)
	R13, R14, R15,		EA8X39		Receptacle (Power Cord)
	R16		EA66X6		Lead, Power
	INIO	L	EA34X12	V1,V2	Socket, Tube (9 Pin)
	COILS		EA46X8		Shield, Tube (9 Pin)
	T		COMMON	RESISTORS +	10% 1/2 WATT
EA36X10	Ll	Coil, Input Frequency Doubler	UNLE	SS OTHERWISE	E SPECIFIED
EA36X11	L2	Coil, Output Frequency Doubler		Rl	1 Mag
EA36X12	L3	Coil, Time Delay		R1 R2	1 Meg 220 Ohm
EA36X13	L4	Coil, Filter #1		R3	820 Ohm
EA36X14	L5	Coil, Filter #2		R5	12 K
COMMON CAPACITORS			R6	12 K	
				12 K 22 K	
				R7	5.6 K
	Cl	.05 MFD - 100V + 20%		R8	• • • •
	C5	500 MMF - 300V + 5%		R9	1 K
	C8	600 MMF - 300V + 5%		R17	470 K
	C15	.05 MFD - 100V + 20%		R18	470 K
	C16	.05 MFD - 100V + 20%		R20 R21	100 K 100 K
	C18	.05 MFD - 200V + 20%			
	C19	.05 MFD - 200V + 20%		R22	3.9 K 3.9 K
	C20	100 MMF - 300V + 5%	<u></u>	R23	
RESISTORS			R24 R25	15 K 15 K	
	7				
EA49X37	R4	Potentiometer, (Variable			
		resistor) 50K			
EA13X1	R19	Resistor, Carbon-2.7K, 1 Watt			

ALL PARTS NOT LISTED BY CATALOGUE NUMBER ARE STANDARD PARTS AVAILABLE FROM YOUR LOCAL PARTS JOBBER

SUBJECT TO CHANGE OR WITHDRAWAL WITHOUT NOTICE

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