MODEL

IG-37 FM Stereo Generator

HEATHKIT®

ASSEMBLY MANUAL

HEATHKIT®

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PRICE $2.00

595-1204-05

INTRODUCTION

The Heathkit Model IG-37 FM Stereo Generator provides "on-the-air-type" signals for aligning monophonic and stereophonic FM receivers. It is a compact, accurate instrument which will produce the following output signals:

- A composite stereo signal for either left or right channel alignment.
- A phase test signal (left plus right channel) for accurate adjustment of subcarrier transformers.
- A pilot signal with adjustable output level for checking the lock-in range of stereo receivers.
- A monophonic FM signal that may be modulated by any one of three modulation frequencies.
- A variable RF oscillator signal with adjustable sweep width and a nominal frequency of 100 MHz.
- Four marker frequencies for RF alignment checks.
- Two SCA (Subsidiary communications authorization) signal frequencies for SCA filter adjustments.
- Completely shielded and selective RF attenuation.

The pilot signal and marker frequencies are crystal controlled for maximum accuracy and minimum frequency drift.

The IG-37 FM Stereo Generator is a precision instrument for service or engineering personnel and other individuals who need an accurate source of signals for the complete alignment of monophonic or stereophonic FM receiving equipment. The Generator is attractive, small in size, and ruggedly built, and it should provide you with many years of trouble-free operation.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

The numbers in parentheses are keyed to the numbers in the Parts Pictorial (fold-out from Pages 3, 4, and 5). NOTE: When more than one number is on a package, disregard all but the part number, as listed below.

To order a replacement part, refer to the Replacement Parts Price List and use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual.

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 Watt		
(1) 1-123	8	100 Ω (brown-black-brown-gold)
1-66	2	150 Ω (brown-green-brown)
1-48	2	390 Ω (orange-white-brown)
1-63	3	510 Ω (green-brown-brown-gold)
1-8	2	820 Ω (gray-red-brown)
1-11	4	1500 Ω (brown-green-red)
1-14	2	3300 Ω (orange-orange-red)
1-43	6	4700 Ω (yellow-violet-red-gold)
1-20	3	10 KΩ (brown-black-orange)
1-69	1	18 KΩ (brown-gray-orange)
1-22	1	22 KΩ (red-red-orange)
1-25	2	47 KΩ (yellow-violet-orange)
1-60	1	68 KΩ (blue-gray-orange)
1-26	2	100 KΩ (brown-black-yellow)
1-27	3	150 KΩ (brown-green-yellow)
1-35	4	1 megohm (brown-black-green)
1-40	1	10 megohm (brown-black-blue)
1/2 Watt Precision 1%		
(2) 2-141	1	166 Ω
2-178	1	1470 Ω (1.47 K)
2-67	1	2725 Ω (2.725 K)
2-180	1	2940 Ω (2.94 K)
2-69	1	4590 Ω (4.59 K)
2-181	1	5490 Ω (5.49 K)
2-155	1	13.5 KΩ
2-182	1	22.1 KΩ
2-183	1	44.2 KΩ
2-184	1	110 KΩ
2-185	1	222 KΩ
2-186	1	280 KΩ
2-187	1	536 KΩ
2 Watt		
(3) 1-16-2	1	330 Ω (orange-orange-brown)
CAPACITORS		
Disc		
(4) 21-3	1	10 pf
Disc (cont'd.)		
21-6	2	27 pf
21-75	1	100 pf
21-22	1	220 pf
21-140	5	.001 µfd
21-35	2	.005 µfd, 1600 V (1.6 KV)
21-95	1	.1 µfd
21-99	1	.2 µfd
Molded Mica		
NOTE: These capacitors may be color coded, or the value may be printed on them. If necessary, refer to the capacitor color code chart and example to help identify these capacitors. Capacitors with the value stamped on them may have a body that is any color.		
(5) 20-39	1	220 pf (red-red-brown)
20-43	1	390 pf (orange-white-brown)
20-89	2	817 pf
20-74	2	4000 pf (yellow-black-red)
Silver Mica		
(6) 20-133	2	430 pf
20-134	1	680 pf
20-122	1	1000 pf
20-137	2	1800 pf
Mylar*		
(7) 27-27	5	.022 µfd
27-28	2	.1 µfd
Electrolytic		
(8) 25-39	1	2 µfd, 150 V
25-20	2	40 µfd, 150 V
(9) 25-178	1	100/40/40 µfd, tab mount
Other Capacitors		
(10) 26-115	1	6.2 pf, variable
(11) 31-9	1	Ceramic trimmer
(12) 31-18	1	Dual ceramic trimmer
(13) 21-142	1	100 pf (brown-black-brown) feedthrough
21-53	2	1000 pf (brown-black-red) feedthrough
(14) 23-74	1	.04 µfd tubular
(15) 28-2	1	1 pf phenolic (brown-black-white-silver)

*DuPont Registered Trademark

CONTROLS

PART No.	PARTS Per Kit	DESCRIPTION
(16)10-214	1	5000 Ω
(17)19-109	1	5000 Ω control with SPST switch
(18)10-52	1	2000 Ω tab mount
10-57	2	10 KΩ tab mount

SWITCHES

(19)60-1	1	SPST slide
60-2	3	DPDT slide
(20)63-445	1	5-position 1-wafer rotary
(21)63-446	1	6-position 2-wafer rotary

COILS-TRANSFORMERS

Coils

(22)45-39	1	RF choke
(23)40-607	1	19 kHz oscillator
40-608	2	38 kHz doubler and buffer
40-610	2	Low-pass input and output filter
40-611	1	Low-pass center-leg filter
40-612	1	100 MHz oscillator
(24)40-609	1	19 kHz phasing

Transformers

(25)52-80	2	38 kHz balanced modulator
54-117-24	1	Power

GROMMETS-INSULATORS-CLAMPS-CLIPS

(26)73-43	2	3/8" plastic grommet
73-45	1	1/2" plastic grommet
(27)73-20	1	Red test clip insulator
73-21	1	Black test clip insulator
(28)75-71	1	Line cord strain relief
75-30	1	Line cord strain relief *(for round line cord)
(29)260-1	4	Alligator clip
(30)260-7	1	Coil mounting clip
260-8	1	Clothespin antenna clip
(31)260-29	2	Crystal clip

*This strain relief is to be used in areas, mainly outside of the U.S.A., where 2 or 3-wire round line cords are required.

CONNECTORS-PLUG-SOCKETS-STRIPS

(32)432-1	1	Female connector
(33)432-3	2	Male chassis connector
(34)438-10	1	300 Ω twin lead plug
(35)434-77	5	Wafer 9-pin tube socket
(36)434-36	1	Ceramic 9-pin tube socket
(37)434-74	2	Crystal socket
(38)434-38	1	Output socket
434-23	1	Lamp socket
(39)431-15	3	1-lug terminal strip
(40)431-50	1	1-lug terminal strip
431-14	1	2-lug terminal strip
(41)431-12	1	4-lug terminal strip
(42)431-40	1	4-lug terminal strip
431-11	1	5-lug terminal strip
431-55	2	6-lug terminal strip

CRYSTALS-DIODES-LAMPS-TUBES

(43)404-245	1	5.35 MHz crystal
(44)404-244	1	19 kHz crystal
(45)56-26	2	Crystal diode
(46)57-27	1	Silicon diode
412-2	1	120 volt 3-watt lamp
(47)412-15	1	Neon pilot lamp (NE-2H)
411-68	1	6AN8 tube
411-114	1	6AU8 tube
411-25	3	12AU7 tube
411-24	1	12AT7 tube

CABLE-SLEEVING-WIRE

347-2	1	300 Ω twin lead
343-2	1	Coaxial cable
89-23	1	Line cord with plug
346-1	1	Sleeving
340-8	1	Bare wire
344-52	1	Red wire
344-53	1	Orange wire
344-55	1	Green wire
344-59	1	White wire
344-56	1	Blue wire
344-54	1	Yellow wire
344-50	1	Black wire

NOTE: The black wire is extra and is to be used if additional wire is needed. For instance, you may possibly cut one of the lengths too short. If this should occur, use the black wire for this entire length instead of splicing two pieces together.

PART No.	PARTS Per Kit	DESCRIPTION
HARDWARE		
#3 Hardware		
(48)250-49	12	3-48 x 1/4" screw
(49)250-133	2	3-48 x 7/16" bronze screw
(50)250-311	1	3-48 x 5/8" screw
(51)252-1	15	3-48 nut
(52)254-7	15	#3 lockwasher
#6 Hardware		
(53)250-270	4	6-32 x 3/8" black screw
(54)250-56	17	6-32 x 1/4" screw
(55)250-229	14	6-32 x 1/4" phillips screw
(56)250-89	3	6-32 x 3/8" screw
(57)250-162	4	6-32 x 1/2" screw
(58)250-365	4	#6 x 1/4" sheet metal screw
(59)250-8	10	#6 x 3/8" sheet metal screw
(60)252-3	18	6-32 nut
(61)254-1	33	#6 lockwasher
(62)259-1	7	#6 large solder lug
(63)259-6	1	#6 small solder lug
(64)250-535	4	6-32 decorative head screw
(65)250-304	4	6-32 mounting stud-spacer
#8 Hardware		
(66)250-137	2	8-32 x 3/8" screw
(67)252-4	2	8-32 nut
(68)253-9	2	#8 flat washer
(69)254-2	2	#8 lockwasher
Other Hardware		
(70)250-3	3	4-40 x 3/16" screw
(71)254-9	3	#4 lockwasher
(72)252-7	6	Control nut
(73)254-4	3	Control lockwasher
(74)259-10	2	Control solder lug
(75)253-10	4	Control flat washer
(76)252-32	1	Push-on speednut
(77)455-50	5	Knob bushing

PART No.	PARTS Per Kit	DESCRIPTION
METAL PARTS		
(78)200-486-1	1	Chassis
(79)203-480-1	1	Front panel
(80)203-481-1	1	Rear panel
(81)90-350-4	2	Cabinet half-shell
(82)204-774-1	1	Left siderail
(83)204-775-1	1	Right siderail
(84)204-759-1	4	Siderail end cap
(85)206-341	1	Oscillator shield
(86)206-342	1	Oscillator shield cover
(87)206-343	1	Attenuator shield
(88)206-344	2	Attenuator shield divider
(89)210-35	1	Bezel
GENERAL		
75-90	1	Insulating paper
(90)206-3	1	Tube shield
(91)211-33	2	Handle
(92)261-30	2	Line cord retainer
(93)261-28	4	Foot
(94)413-10	1	Red lens
(95)462-245	5	Knob
(96)481-1	1	Capacitor mounting wafer
(97)391-34	1	Blue and white label
(98)490-1	1	Plastic alignment tool
(99)490-5	1	Nut starter
597-260	1	Parts Order Form
597-308	1	Kit Builders Guide
	1	Manual (See front cover for part number.)
		Solder

NOTE: The prices shown on the separate "Heath Parts Price List" apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering (Michigan residents add 4% sales tax) to cover insurance, postage, and handling. Outside the U.S.A., parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties, and rate of exchange.

GENERATOR ALIGNMENT

Before starting the alignment procedure, carefully study the operation of each control and switch as described in Figure 1 (fold-out from this page).

EQUIPMENT REQUIRED

1. AC VTVM.
2. FM tuner or receiver.
3. Oscilloscope.

Refer to Figure 2 (fold-out from Page 39) for the adjustment locations and to Figure 3 (fold-out from Page 39) for the test point locations. If you do not obtain the proper results in the following tests, or if improper operation occurs, refer to the In Case Of Difficulty section on Page 43.

19 kHz OSCILLATOR ADJUSTMENT

( ) Turn on the Generator with the PILOT LEVEL control. The PWR ON lamp and all tube filaments should glow. The 3 watt lamp should not light. If everything appears normal, proceed with the following steps.

( ) Place the FUNCTION switch in the AUDIO/MONO FM position and the FREQUENCY switch in the 5000 Hz position. Allow the Generator and test equipment to reach normal operating temperature.

( ) Connect either an AC VTVM or Oscilloscope (or both) to test point TP-1. A 19 kHz waveform with an amplitude of at least 1 volt rms should be present.

( ) Adjust the slug in coil L1 clockwise (viewed from the bottom of the chassis) until the 19 kHz oscillator stops oscillating as indicated by a sharp decrease in the voltage or oscilloscope signal at test point TP-1.

( ) Adjust the slug in coil L1 counterclockwise until the oscillator just starts to oscillate. Now turn the slug one full turn counterclockwise. If the voltage reading is greater than 3 volts rms, continue to turn the coil counterclockwise until the voltage decreases to 3 volts rms. If you cannot adjust the voltage down to 3 volts rms, or if the reading is below 1 volt rms, refer to the In Case Of Difficulty section.

AUDIO OSCILLATOR ADJUSTMENT

( ) Connect the AC VTVM or Oscilloscope (or both) to the COMPOSITE SIG/AUDIO connector on the front panel.

( ) Turn the FUNCTION LEVEL control fully clockwise.

( ) Adjust the OSC ADJUST control (top of chassis) until oscillation occurs as shown by a reading on the AC VTVM or a waveform on the oscilloscope.

( ) Turn the FREQUENCY switch to the 19 kHz position. The voltage should be between .95 and 2 volts rms. Note the voltage reading. Now turn the FREQUENCY switch back to the 5000 Hz position and adjust the OSC ADJUST control until the same voltage reading, as noted in the 19 kHz position, is obtained.

( ) Turn off the Generator and disconnect the AC VTVM and Oscilloscope.

AUDIO OSCILLATOR CALIBRATION

The audio oscillator calibration requires temporarily connecting two precision resistors in its circuit. After calibration, the oscillator circuit will be returned to its normal configuration.

Refer to Figure 3 for the following steps.

( ) Disconnect the white wire at lug 2 of trimmer capacitor BF. Move this wire up out of the way.

( ) Unsolder the lead of the 1000 pf silver mica capacitor connected to lug 6 on wafer B of switch AA.

( ) Locate the 4590 Ω and the 13.5 KΩ precision resistors. Twist together and solder the leads at one end of these precision resistors.

( ) Tack-solder the twisted-together leads to test point TP-2 (lug 2 of trimmer capacitor BF).

( ) Tack-solder the free lead of the 13.5 KΩ precision resistor to lug 1 of trimmer capacitor BF.

( ) Tack-solder together the free lead of the 4590 Ω precision resistor and the free lead of the 1000 pf silver mica capacitor as shown in Figure 3. This is test point TP-3.

( ) Connect the horizontal input of the oscilloscope to test point TP-1. Set the oscilloscope horizontal sweep control to the external sweep position.

( ) Connect the vertical input of the oscilloscope to the COMPOSITE SIG/AUDIO output connector on the front panel.

( ) Turn on the Generator and adjust the FREQ ADJUST trimmer, from the top of the chassis, until the oscilloscope trace becomes a circle (a type of Lissajous figure) indicating a beat of 1 Hz or less.

( ) Turn off the Generator and disconnect the oscilloscope leads. Then remove the precision resistors.

( ) Permanently reconnect the white wire to lug 2 of trimmer capacitor BF.

( ) Permanently reconnect the 1000 pf resin capacitor to lug 6 on wafer B of switch AA.

38 kHz SYNC ADJUSTMENT

( ) Connect the oscilloscope or AC VTVM to test point TP-4.

( ) Turn on the generator.

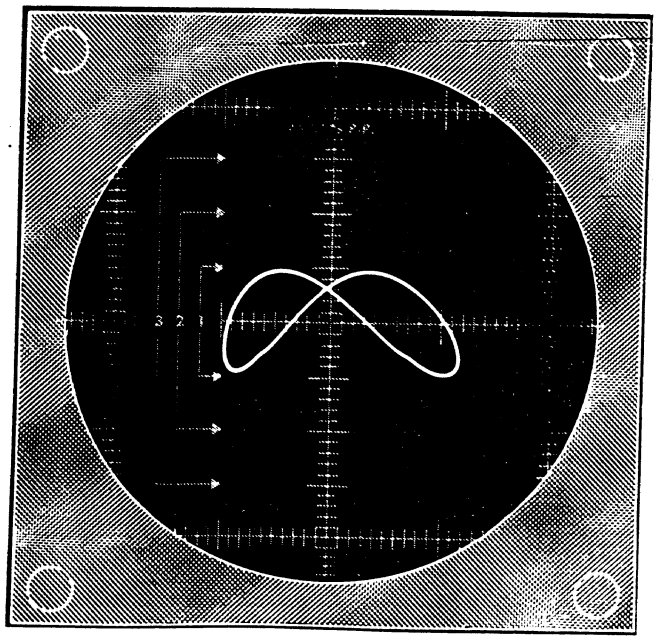
( ) Adjust the slugs in coils L2 and L3 for a maximum voltage indication. This voltage should have an amplitude of 1 to 2 volts rms.

( ) Disconnect the oscilloscope or AC VTVM that is connected to test point TP-4.

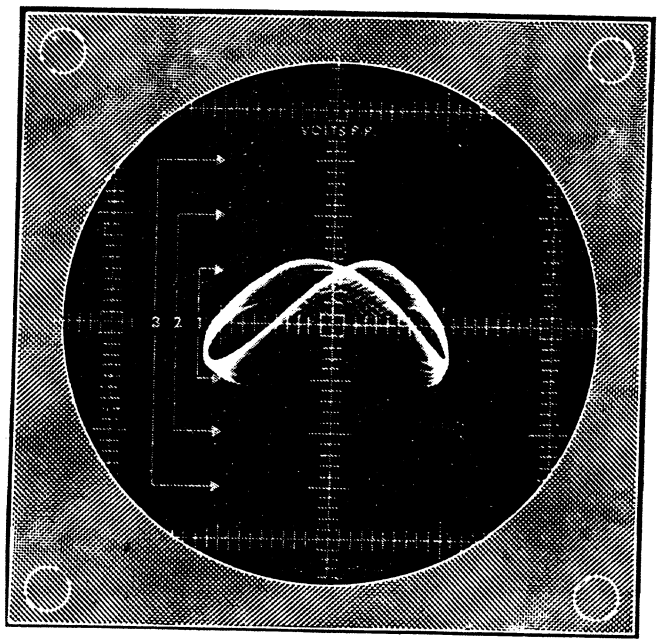
( ) Connect the oscilloscope horizontal input to test point TP-1 and the vertical input to the COMPOSITE SIG/AUDIO connector on the front panel.

( ) Turn on the Generator and place the FREQUENCY switch in the 38 kHz position.

( ) Adjust the 38 kHz SYNC trimmer capacitor (on the rear panel) until a steady trace appears on the oscilloscope. This trimmer should be adjusted to the lowest capacitance necessary to maintain a steady trace on the oscilloscope. See Figure 4. NOTE: The trimmer capacitance is decreased by turning the screw counterclockwise.



CORRECT



INCORRECT

Figure 4

( ) Connect the AC VTVM to the COMPOSITE SIG/AUDIO connector and measure the voltage obtained with the FREQUENCY switch in the 19 kHz position and then in the 5000 Hz position. The voltage should be the same for both switch positions. If the voltage is not the same, turn the FREQUENCY switch to the 5000 Hz position and readjust the OSC ADJUST control until the voltage readings are identical.

NOTE: If there is any variation in the amplitude of the waveform for any switch position (amplitude modulation), leave the switch in that position and turn the OSC ADJUST control slightly clockwise to stabilize the waveform.

BALANCED MODULATOR ADJUSTMENT

( ) Turn the PILOT LEVEL control fully counterclockwise (but do not turn the Generator off) and turn the FUNCTION switch to the PHASE TEST position. Disconnect the oscilloscope horizontal input lead from test point TP-1. Set the oscilloscope controls for internal sweep.

( ) Remove the 12AU7 tube from socket V1.

( ) Preset the BALANCE control, on the rear panel, to its center-of-rotation position.

( ) Connect the AC VTVM and the oscilloscope to the COMPOSITE SIG/AUDIO connector on the front panel. Alternately adjust transformers T2, T3, and the BALANCE control for a minimum voltage indication. This minimum voltage should be between approximately .01 and .05 volts rms.

( ) Replace the 12AU7 tube in socket V1. Leave the oscilloscope connected to the COMPOSITE SIG/AUDIO connector.

PILOT LEVEL ADJUSTMENT

( ) Turn the FREQUENCY switch to the 1000 Hz position and adjust the slugs in coils L5, L6, and L7 until the waveform shown in Figure 5 is obtained.

( ) Connect the oscilloscope to test point TP-5 and turn the PILOT LEVEL control fully clockwise.

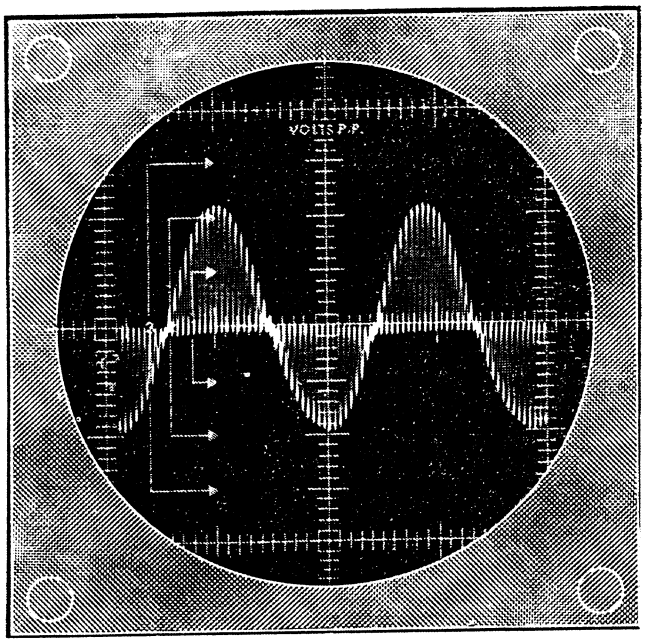


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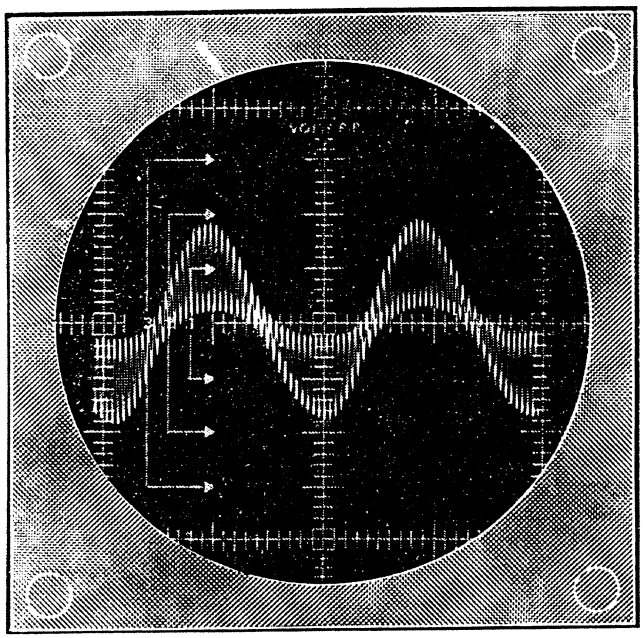
Figure 5



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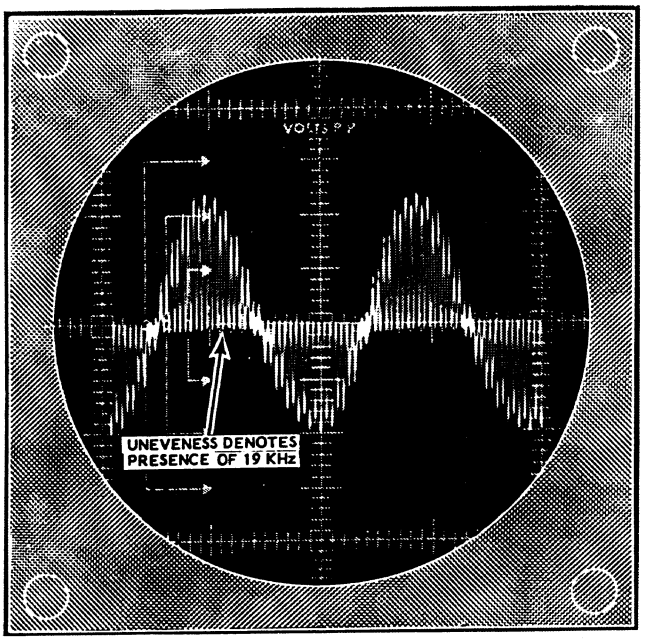

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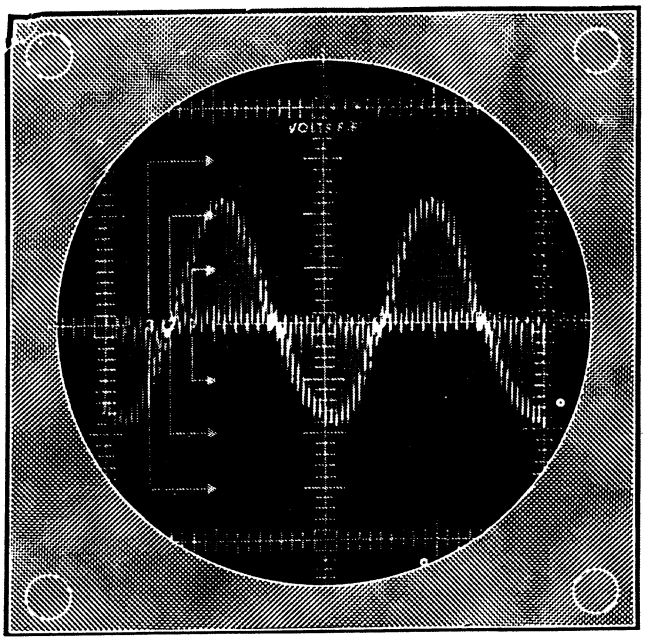

INCORRECT

Figure 6

( ) Adjust the slug in coil L4 for minimum height of the 19 kHz signal at the center of the waveform. See Figure 6.

( ) Adjust the PILOT LEVEL trimmer capacitor on the rear panel, for minimum capacitance (maximum counterclockwise rotation without the adjustment screw becoming loose).

( ) Turn the FUNCTION switch to the LEFT CHANNEL position.

( ) Adjust the PILOT LEVEL trimmer capacitor, on the rear panel, to obtain a 19 kHz signal at the center of the waveform. The amplitude of the 19 kHz signal should be equal to 10% of the entire composite signal pattern. See Figure 7.

( ) Turn the FUNCTION switch to the PHASE TEST position and recheck the adjustment of coil L4. Readjust the slug in coil L4 if necessary.

( ) Again turn the FUNCTION switch to the LEFT CHANNEL position and recheck the setting of the PILOT LEVEL trimmer capacitor.

( ) Turn the FUNCTION switch to the RIGHT CHANNEL position. The 19 kHz signal at the center of the waveform should again be only 10% of the entire composite signal pattern. See Figure 7.

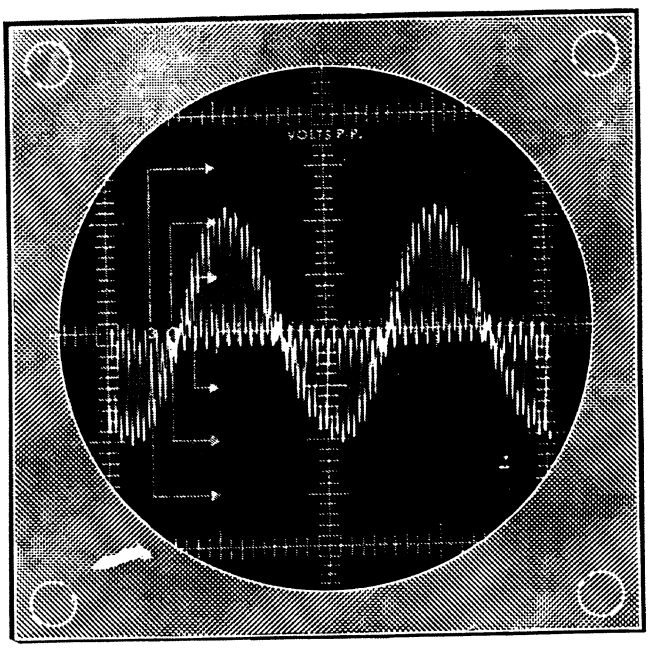

Figure 7

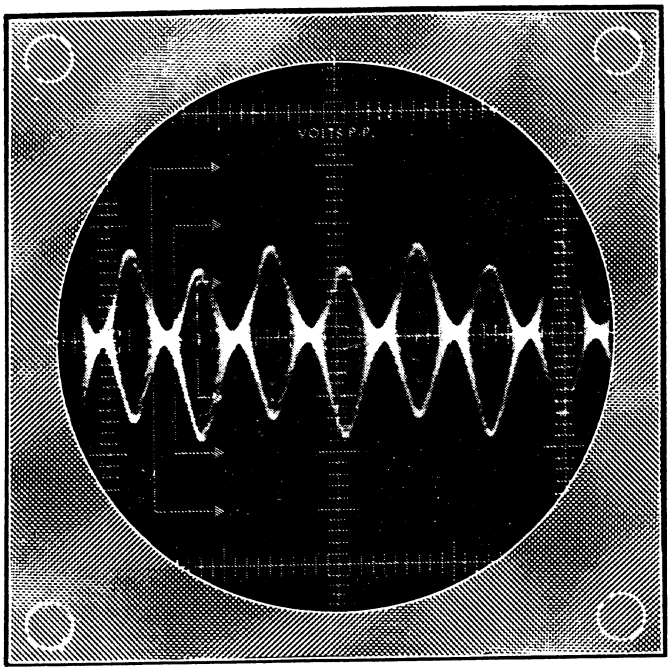

Figure 8A
PHASE TEST

OPERATION CHECK

( ) Turn the FUNCTION switch to the PHASE TEST position.

( ) Connect the oscilloscope external sync input to test point TP-1 and the vertical input to the COMPOSITE SIG/AUDIO connector on the front panel.

( ) Set the oscilloscope for external sync and the oscilloscope sweep rate to the 10-100 kHz range.

( ) Refer to the oscilloscope patterns shown in Figures 8A, 8B, and 8C. Then compare these patterns to the ones you obtain on your oscilloscope with the FUNCTION switch in the PHASE TEST, LEFT CHANNEL, and RIGHT CHANNEL positions.

( ) Disconnect the oscilloscope leads.

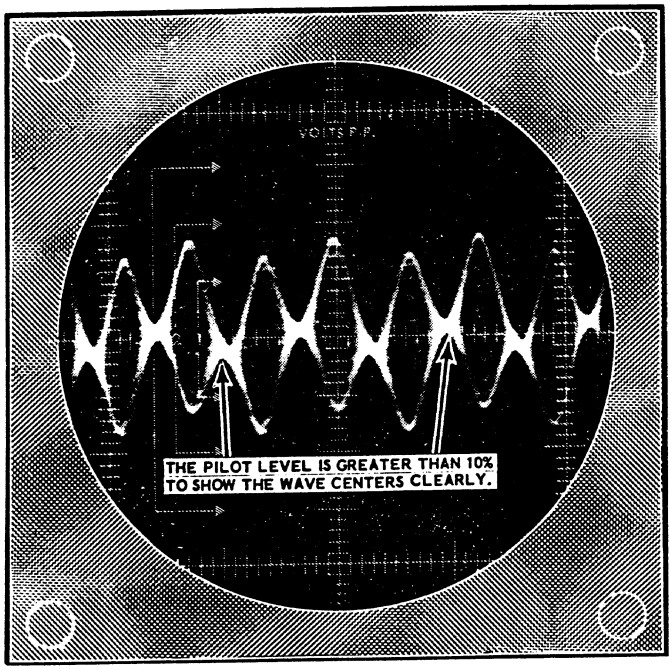

Figure 8B
LEFT CHANNEL

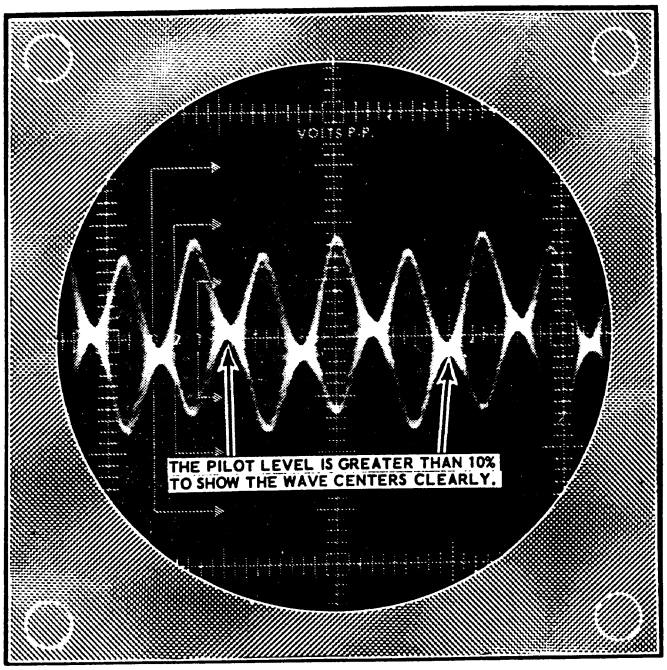

Figure 8C
RIGHT CHANNEL

MODULATION LEVEL CHECK

( ) Turn the FUNCTION switch to the AUDIO/MONO FM position and turn the MOD ADJUST control fully counterclockwise.

( ) Connect the AC VTVM to test point TP-6, and turn the FREQUENCY switch to the 1000 Hz position.

( ) Adjust the MOD ADJUST control for a reading of .95 volts rms (2.7 volts peak-to-peak). (NOTE: This adjustment can also be made by comparison, using a known standard of 75 kHz deviation, or by using a deviation meter especially designed for this purpose.)

( ) Disconnect the AC VTVM from test point TP-6.

RF OSCILLATOR ADJUSTMENT

( ) Set the RF FREQ ADJUST control to its mid-range position.

( ) Turn on and tune an FM tuner or FM radio to 100 MHz.

( ) Adjust the slug in coil L8 until the RF output signal from the Generator can be heard coming from the FM tuner or radio. NOTE: If you cannot hear the RF signal from the Generator, plug the previously made-up twin lead cable into the RF OUT socket on the front panel of the Generator. Connect the other end of the twin lead cable to the antenna input terminals on the FM tuner or radio.

( ) Turn the RF FREQ ADJUST control on the front panel of the Generator through its full range. The RF output signal from the Generator should shift in frequency approximately plus and minus 2 MHz.

This completes the Alignment of your FM Stereo Generator. The alignment should be rechecked after a few weeks of use since it may change slightly due to aging of the components. Proceed to the Final Assembly section.