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ASSEMBLING AND  
USING YOUR

*Heathkit*

Signal Generator  
Model G-5



THE HEATH COMPANY  
BENTON HARBOR, MICH.

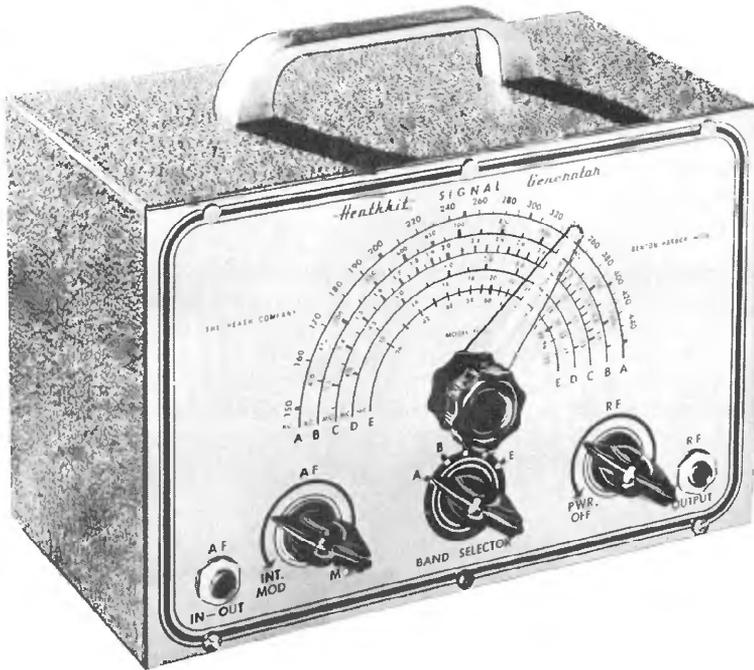
PRICE \$1.00

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# Assembly and Operation of Heathkit Signal Generator

## MODEL G-5



### SPECIFICATIONS

#### FREQUENCY RANGE

Band A-----	150 Kc. to 450 Kc. . . . .
Band B-----	450 Kc. to 1300 Kc.. . . .
Band C-----	1.3 Mc. to 4 Mc. . . . .
Band D-----	4 Mc. to 12 Mc. . . . .
Band E-----	12 Mc. to 34 Mc. . . . .
Calibrated Harmonics-----	36 Mc. to 102 Mc. . . . .

RADIO FREQUENCY OUTPUT -----In excess of 100,000 microvolts . . . . .

MODULATION FREQUENCY -----Approximately 400 cycles . . . . .

AUDIO OUTPUT -----2 to 3 Volts. . . . .

AUDIO FREQUENCY INPUT -----Low Impedance. . . . .

#### TUBES

6SN7 Twin Triode -----	RF Oscillator and Audio Amplifier . . . . .
6X5-----	Power Rectifier . . . . .

POWER REQUIREMENTS-----105-125V. 50/60 cycles . . . . .

## CIRCUIT DESCRIPTION

The Heathkit Model G-5 Signal Generator incorporates the best features developed from the manufacture of many thousands of signal generator kits. From its satin finished streamline aluminum handle to the quality varnish impregnated power transformer, it represents the best quality of material.

The oscillator coils are precision wound and adjusted to calibration before shipment assuring maximum accuracy.

The coils together with tuning condenser and band switch all mount on a turret which allows easy convenient assembly and maintains extremely short wiring leads.

The audio oscillator is a relaxation type using a neon bulb as the discharge device. A condenser across the neon bulb is charged until it reaches the discharge voltage at which time the neon bulb flashes causing a pulse. The resistors in the circuit are chosen to allow the charge discharge cycle to be approximately 400 cycles per second. This pulse is of the saw-tooth type which is very useful in checking the characteristics of audio amplifiers.

The audio control has a special type switch attached. This switch is actuated at each end of the control rotation allowing the control to be used in either switch position. Thus with the switch in internal position, the control regulates the amount of audio output while with the control in external position the control regulates the amount of external modulation.

The power supply uses a 110 Volt 50/60 Cycle power transformer with full wave rectifier. This allows the generator to be used safely on any type receiver. The 110 Volt power line has both sides bypassed to minimize the signal feeding back through the power lines.

## CONSTRUCTION

The construction of this instrument is not difficult, but as this is a delicate test instrument which will be useful for many years, it deserves the best of careful workmanship. Poor construction will result in an inaccurate instrument.

Thoroughly familiarize yourself with the layout, schematic and pictorial diagram. Do not rush the construction. Make a good mechanical joint of each connection and then solder it with the best quality of rosin core radio type solder. Hold each joint rigid until cool and then test by attempting to pull the joint loose. Most difficulty in construction results from improper wiring and poor soldered connections.

Begin by checking the parts against the parts list. Identify each part. This will avoid throwing away any small parts in the packing. Use the charts to identify resistors and condensers.

From time to time, small changes in parts will be made by the Heath Company. All parts supplied will work just as well as the part for which it was substituted. 47,000 ohm resistors (which is the new radio manufacturers rating for 50,000 ohms) may be substituted for 50,000 ohms or a one watt resistor may be substituted for  $\frac{1}{2}$  watt, etc. All substitutions will be of equal or better quality than the original and will be made in order that a minimum delay will occur in filling your order.

The newer types of insulated resistors have a higher wattage rating. The  $\frac{1}{4}$  watt size is now rated at  $\frac{1}{2}$  watt and these are used in this kit. Bolts and nuts are counted mechanically, and if a few are missing, please secure locally.

Resistors and potentiometers have a tolerance rating of plus or minus 20% unless otherwise stated. Therefore, a one megohm unit may test between 800,000 and 1,200,000 ohms. The Heathkit circuits are designed to accommodate these variations.

The socket connections are numbered on the bottom of the sockets. They are fastened into the chassis with the wavy metal rings which are forced over the bottom of the socket and into the grooves in the socket.

19. Assemble test lead as shown in the pictorial, using the shielded wire (V47) and connecting first the phone plug with the center conductor of the wire going to the center contact on the plug. Screw the cap over the plug before attaching the alligator clips (V44) to the center conductor and the shield at the other end of the test lead.

Plug the 6X5 and the 6SN7 tubes into their proper sockets and the generator is ready for test.

### CALIBRATION

On a receiver, tune in a strong station of known frequency between 1,000 and 1,250 Kc.

Place the test lead from the generator close to the antenna of the receiver and tune the generator to approximately the same frequency, which will result in a whistle in the receiver.

The lowest pitch whistle (zero beat) indicates signal generator and station to be on the same frequency. Now set indicator to read the same frequency as the station and adjust trimmer to give again zero beat. The trimmer should be nearly unmeshed.

The calibration will now hold quite accurately on all bands.

The calibration on the higher frequency bands may be upset by excessively long leads on the tuning assembly and by failure to ground all coils to the common solder lug. Such variations in inductance cannot be compensated for by trimmer adjustment.

If the trimmer is fully unmeshed before zero beat is again obtained, there is an excessive amount of distributed capacity due to wiring in the tuning circuits. Make sure all the "hot" leads (from the top lug on the coils to the switch, and from the switch to the tuning condenser and trimmer) are at least a quarter inch away from the metal chassis and all other wiring.

### ACCURACY

Any signal generator is designed as a controllable source of modulated or unmodulated signals, that can readily be identified. No signal generator is designed as a frequency standard. Expensive standard signal generators have fairly accurate (3-20%) attenuators, which control the output voltage, and the calibration accuracy is rarely closer than 1%. The Heathkit generator may be expected to fall within 2-3% of the frequency calibration, which is quite satisfactory for service work and alignment. In receiver alignment, the frequency at which the particular adjustment is made is rarely critical, but the adjustment itself for maximum signal output from the receiver is frequently quite critical.

For calibration of home built receivers or equipment with great accuracy proceed as follows:

Make a rough calibration with the signal generator. Then with a receiver tune in WWV (Bureau of Standards) at 2.5, 5 or 10 Mc. Set the signal generator to a suitable subharmonic, such as for instance 500 Kc, and adjust for zero beat. Now the harmonics of the signal generator occur very accurately every 500 Kc. and may be used to give accurate calibration points at 500 Kc. intervals, like for instance 2500 Kc.-3000 Kc.-3500 Kc.-4000 Kc. These points can then be used to correct the rough calibration, which is merely used to distinguish between the many harmonics available. For calibration of higher frequency equipment, a choice of a higher sub harmonic will reduce confusion between the multitude of harmonics and insure adequate signal strength.

When checking the calibration accuracy of the Heathkit generator, the most convenient standards of comparison, of sufficient accuracy, are broadcast stations of known frequency. Crystal oscillators of standard frequencies, when zero beat against WWV, are also convenient to use, if available. The use of receiver dial calibrations is frequently not of sufficient accuracy to warrant consideration.

### USE OF R. F. SIGNAL GENERATOR

This signal generator is used to align radio receivers. A variable source of radio frequency or modulated radio frequency waves on fundamentals between 150 Kilocycles and 34 Megacycles (Megacycle=1,000 Kilocycles) with useful calibrated harmonics to over 100 Megacycles.

A source of 400 cycle saw tooth audio waves is also provided which is useful in testing amplifiers and speakers.

Wherever possible, the recommendations of the manufacturer of the radio being aligned should be used. When this is not available, the following procedure can be followed.

**Output Indication.** With the newer types of receivers, especially those using AVC (automatic volume control), a visual means of indicating resonance is desirable. This may be an output meter (AC voltmeter) or oscilloscope, connected to the speaker voice coil terminals, or output tube plate and ground. Or a DC vacuum tube voltmeter connected across the diode load resistor may be used.

**IF Alignment.** Connect the signal generator shield to chassis and clip the shielded wire to the signal grid terminal on the converter tube socket. Set the signal generator to the IF frequency required. RMA standard is 455 Kc., but other frequencies like 262 and 175 Kc. are also used. Adjust generator output for minimum readable output indication. Adjust IF transformers starting with the one nearest the second detector and working forward. The adjustment consists generally of two screws, operating trimmer condensers, or iron cores inside the coils. They may be located on top, on the side or on top and bottom of the IF transformer. Turn the adjusting screw for maximum output, reducing the signal generator output if necessary to keep the output indicator from going off scale.

**Oscillator Alignment.** With the generator connected as above, set dial to highest frequency of receiver dial (1600 or 1720 Kc.) and set receiver dial to the same frequency. Adjust oscillator trimmer to bring in the signal. An additional adjustment is often provided in the form of a padding condenser or an iron core. This is generally adjusted at 600 Kc. and its final adjustment is made later.

**RF Alignment.** Using a 200 MMF condenser between generator and antenna post, set receiver and generator to 1400 Kc. Adjust antenna (and RF, if used) trimmer (frequently located on the tuning condenser) for maximum output. Set generator to 600 Kc. and "rock" tuning condenser through the signal while adjusting the oscillator paddler for maximum output at resonance.

For receivers with a loop antenna, couple the signal through a single turn loop connected to the generator output.

Tuned radio frequency receivers are aligned as shown under RF Alignment.

#### OUTPUT VOLTAGE

The RF signal strength going into the output control depends upon the strength of oscillation of the 6SN7. In all variable frequency oscillators, the amplitude will vary with the tuning condenser setting. With careful design, the variation may be minimized. In the Heathkit signal generator, the variation is kept down to about two to one on each band, except on band E where the L/C (inductance to capacitance) ratio becomes sufficiently unfavorable, that oscillation may stop with the tuning condenser nearly fully closed. However, sufficient overlap is provided to insure complete frequency coverage. The variation between bands is such as to provide a greater signal strength at the lower frequencies. This permits a signal to be "forced through" a badly misaligned IF channel. The maximum output on all bands is usually greater than 100,000 microvolts.

#### IN CASE OF DIFFICULTY

1. Recheck entire wiring. Follow each lead and color it on the schematic with colored pencil. Most cases of difficulty result from wrong or reversed connections. (Often having a friend check the wiring will divulge an error being consistently overlooked.)
2. Be sure that the output is connected to the tip connection of the jack and that the output cable is not shorted inside the phone plug.

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3. Check the voltages. The table below lists voltages from pins of 6SN7 to chassis. These voltages were measured with an 11 megohm input vacuum tube voltmeter. A normal variation of  $\pm 15\%$  is to be expected.

Pin 1	0	Pin 5	80-120V
Pin 2	80-120V	Pin 6	(Band "A" only) 3-5V
Pin 3	3-5V	Pin 7	5-6V AC
Pin 4	1-10V Neg.	Pin 8	0

With regular voltmeters, readings may be very much lower.

4. If you are unable to obtain results, write the Heath Company, giving all possible information, such as voltages obtained, indications if any, and all other helpful information.
5. If desired, your instrument may be returned to the factory. The Heath Company will check and put it into operating condition for a charge of \$3.00 plus any parts or alterations required due to damaged or improper construction.

**NOTE:** Before returning your instrument to factory, be sure to install all panel and chassis mounting screws, including those in rear of cabinet.

Tighten power transformer securely.

Attach a tag, giving name, address and trouble experienced, to your instrument.

Pack instrument in a rugged container, preferably wood using at least three inches of shredded newspaper or excelsior on all sides. Do not use folded newspaper. Do not ship in original carton only.

Ship by prepaid express if possible. Return shipment will be made by express collect.

**NOTE** that a carrier cannot be held liable for damage in transit if packing, in HIS opinion, is insufficient.

Prices subject to change without notice. The Heath Company reserves the right to change the design of its instruments without incurring liability for equipment previously supplied.

## WARRANTY

The Heath Company limits its warranty on any part supplied with any Heathkit (except tubes, meters, and rectifiers, where the original manufacturer's guarantee only applies) to the replacement within three (3) months of said part which, when returned with prior permission, postpaid, was, in the judgment of the Heath Company, defective at the time of sale.

The assembler is urged to follow the instructions exactly as provided. The Heath Company assumes no responsibility for the operation of the completed instrument, nor liability for any damages or injuries sustained in the assembly or operation of the device.

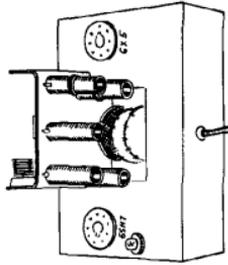
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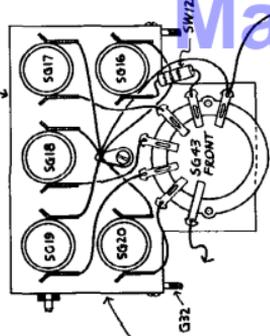
Part No.	Parts Per Kit	Description	Part No.	Parts Per Kit	Description
<b>Resistors</b>					
SW12	1	1000 Ohm Resistor	SG17	1	Oscillator Coil 450-1300 KC
K10	1	2700 Ohm Resistor	SG18	1	Oscillator Coil 1.3-4.0 MC
G12	1	5600 Ohm Resistor	SG19	1	Oscillator Coil 4.0-12 MC
O11	1	10,000 Ohm Resistor	SG20	1	Oscillator Coil 12-34 MC
SW13	1	22-24,000 Ohm Resistor	SG22	1	Neon Bulb
O10	2	3.3 Megohm Resistors	C25A	1	Neon Bulb Socket
<b>Condensers</b>					
G24	1	50 MMF (.00005MFD) Cond.	K17	2	Phone Jacks
SG46	2	.001 MFD Fixed Cond.	V41	1	Phone Plug
SG13	2	.002 MFD Fixed Cond.	V44	2	Alligator Clips
T13	2	.01 MFD Fixed Cond.	O34	4	Rubber Feet
T12	1	.1 MFD Fixed Condenser	O35	1	3/8" Rubber Grommet
G25	1	50 MMF Air Trimmer Cond.	C24	1	7/16" Rubber Grommet
SG40	1	360 MMF Tuning Cond.	G32	2	Spade Bolts
K13	1	20-20 MFD 150 V Cond.	G31	2	#4-40 x 3/8" Screws
<b>Controls &amp; Switches</b>					
SG42	1	1500 Ohm Control with special switch	K16	2	#6-32 x 3/16" Screws
SG11	1	10,000 Ohm Control with Sw.	O31	6	#6-32 x 3/8" Screws
SG43	1	2 circuit 5 Pos. Band Switch	O30	2	#10-24 x 3/8" Handle Screws
<b>Tubes</b>					
V30	1	6X5 Tube	O102	2	#6 - 3/8" Sheet Metal Screws
G44	1	6SN7 Tube	TS55	1	#8-32 x 1/8" Set Screw
<b>Miscellaneous</b>					
O54	2	Octal Sockets	S22	12	#6-32 Nuts
O43	2	Octal Socket Rings	O33	5	Control Nuts
O51	5	Pointer Knobs	TS72	17	#6 Lock Washers
SG44	1	Knob	O28	4	3/8" Nickel Washers
SG45	1	Indicator Assembly	O101	2	Lock Washers
S32	1	2 Lug Terminal Strip	O37	4	Solder Lugs
SW37	1	3 Lug Terminal Strip	V47	1	Length Shielded Test Lead Wire
SG16	1	Oscillator Coil 150-450 KC	T24	1	Roll Hook-up Wire (10')
			IB43	1	Length #20 Bare Wire (18")
			S16	1	Length Spaghetti (8")
			O78	1	Line Cord
			O79	1	Handle
			V32	1	Power Transformer (P121)
			SG26A	1	Panel
			SG27A	1	Chassis
			SG28	1	Sub Chassis
			T32	1	Cabinet
			G-5	1	Instruction Manual

HEATH COMPANY  
Benton Harbor, Michigan

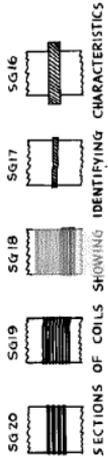
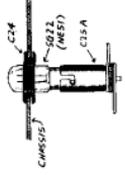
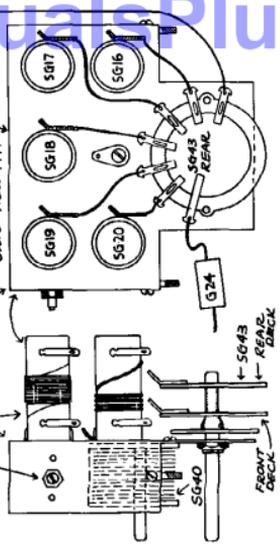




Connections nearest the Subchassis only shown in this view....



Connections farthest from Subchassis only shown in this view....



# Heathkit

## SIGNAL GENERATOR

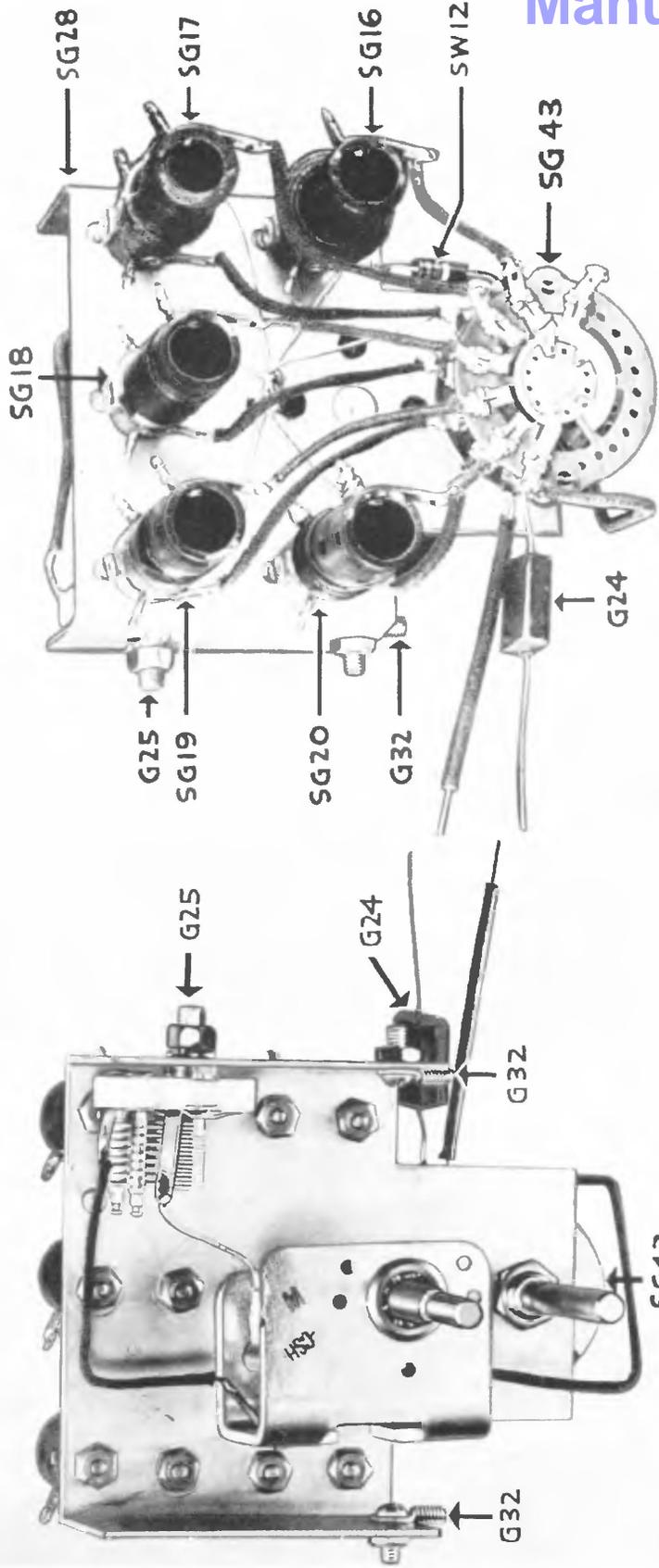
MODEL G-5

THE HEATH COMPANY  
BENTON HARBOR, MICH.

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SG39

# Heathkit SIGNAL GENERATOR ... MODEL G-5



COIL TURRET...FRONT VIEW  
 The HEATH COMPANY  
 BENTON HARBOR, MICH.

COIL TURRET...REAR VIEW  
 8/16/49  
 SG-34A