

Heathkit®

VFO

FET (field effect transistor) Q102 and its associated components make up a Hartley oscillator. Part of coil L118, Main Tuning capacitor C1, and fixed temperature-compensating capacitors C182 through C188 are used in the frequency-determining circuit of the VFO (variable frequency oscillator). The remaining part of L118 is used to couple back part of the generated signal to the drain (D) of Q102 to help sustain oscillation. The VFO generates frequencies between 5.9993 MHz and 5.7493 MHz.

Diode D119 clamps the positive-going half of the signal to prevent Q102 from reaching high peak operating currents. This helps to keep the VFO from generating harmonic signals.

The signal at the output of Q102 is coupled through C194 to the gate (G) of source follower Q105, which acts as a buffer and impedance-matching device. Q106 is a fixed-tuned amplifier that is followed by a low-pass filter, which reduces the harmonic output of the VFO. The VFO signal is then coupled to gate 1 (G1) of 1st mixer Q107.

RIT

The RIT circuit is in parallel with Main Tuning capacitor C1 of the VFO. This circuit, which is controlled by a +12 VDC switching voltage (+R in receive and +T in transmit) through Q103, causes a small change in the capacitance of D118 by varying the voltage across it. In the receive mode, RIT control R1 is used to vary this voltage, which results in a tuning range of ± 1 kHz (with respect to the receiver frequency). In the transmit mode, Transmit Return control R131 ensures that a constant voltage is applied across D118, regardless of the setting of the RIT control.

HFO

The HFO (heterodyne frequency oscillator) operates on any of eight crystal-controlled frequencies, depending on which band position is selected by Band switch SW1. The HFO signals for 80, 40, 30, and 20 meters are produced by Q108 and its associated circuitry. Q109 and its associated components produce the HFO signals for 17, 15, 12, and 10 meters.

The signal from either HFO transistor is coupled to the base of HFO emitter follower Q111. The HFO signal is then coupled through C175 to gate 2 (G2) of 1st mixer Q107.

1ST MIXER

Q107 produces the appropriate premix signal for the selected band by mixing the VFO and HFO signals. The premix signal is used in both the receive and transmit modes of operation.

PREMIX FILTERS

The unfiltered premix signal is applied to one of the eight diode switched filters and tuned circuits selected by Band switch SW1. The selected filter suppresses all unwanted signals; only the desired premix signal passes through C101 to the base of amplifier Q101. The filtered and amplified signal is then coupled through C103 to 2nd mixer U401 on the T/R circuit board. This circuit will be discussed later.

BFO

This circuit produces an 8.8314 MHz signal in the receive mode, while an 8.8307 MHz signal is generated in the transmit mode. To accomplish this task, Q112 is used in a VXO (variable crystal oscillator) circuit.

In the receive mode, crystal Y109, coil L135, and capacitors C206 through C208 determine the oscillator frequency.

D142 clamps the positive-going half of the signal to prevent Q112 from reaching high-peak operating currents. This helps to keep the oscillator from generating harmonic signals.

C211 couples the oscillator signal from the source (S) of Q112 to the base of emitter follower Q113, which acts as a buffer stage. Part of the signal from Q113 is coupled to product detector U303, which will be discussed later.

In the transmit mode, a +12 volt switching voltage (+T) is fed to resistor R151 to turn on D141. This allows the circuit, which is made up of L134 and C205, to produce a fixed offset frequency of 700 Hz

during transmit. At this time, emitter followers Q114 and Q115 are also turned on by the "+T" switching voltage. The 8.8307 MHz output signal at the emitter (E) of Q115 is coupled through C217, where its amplitude is controlled by CW Level control R2. This controlled level is coupled through C218 to a low-pass filter to suppress the harmonic output of the BFO. The filtered BFO signal is coupled to 2nd mixer U401.

2ND MIXER

U401 is a double-balanced mixer that is used in both the receive and transmit modes of operation.

In transmit, D303 is forward biased and the TX signal is fed from the BFO to U401, where the signal is mixed with the premix signal supplied by Q101 on the oscillator circuit board. At the same time, a +12 volt switching voltage (+R) is removed from the anode end of D301 and D302, and "+T" applies a reverse bias voltage to these diodes.

The signal at the output (pin 1) of U401 is coupled through impedance-matching transformer T401 to the input of the selected bandpass filter (one of eight possible filters). A "+T" voltage is applied to the anode of D401, which permits the signal to be coupled to the base of Q401. At the same time, the "+T" voltage is also applied to the cathode of D403, which isolates the receive line from the transmit line.

From the emitter of amplifier Q401, the signal is fed to the base of amplifier Q402; and from Q402's emitter, the signal is applied to the base of driver Q404. At this time, keying transistor Q403 keeps Q404 turned on. Q404 amplifies the signal, couples it through impedance-matching transformer T402, and then applies the signal to the base of each of the two PA transistors, Q405 and Q406. Zener diode D405 prevents excessive RF voltages on the collectors of these transistors from destroying them under no-load and high-SWR conditions.

From the output of the PA transistors, the amplified RF signal is fed to matching transformer T403 and then coupled to the low-pass filter in use for that band. The resulting filtered signal is then applied to antenna jack J4.

In receive, the signals received by the antenna are coupled through the proper low-pass filter and C443. A "+R" voltage is applied to the anode of D404 and D407, which allow the signal to pass through matching transformer T404 and continue through the selected bandpass filter; thus taking the same path (but opposite direction) as the transmit signal to the 2nd mixer.

At the 2nd mixer, the receive signal is mixed with the premix signal; thus, a resulting 8.83 MHz IF signal is coupled through switching diodes D302 and D301, which are forward biased by the "+R" voltage. This signal is now coupled through matching transformer T301 to the gate of common source IF amplifier Q301, which receives its operating voltage from the switched "+R" line. The resulting IF signal passes through FL301 and is further amplified by 2nd IF amplifier U301. From the output of U301, the amplified signal is coupled to matching transformer T302.

C327 couples a portion of the signal at the output of T302 to the AGC loop. This signal is now rectified by D309 and D311 and filtered by C328. The resulting negative voltage is fed to the input (pin 2) of AGC amplifier U302. A fixed positive reference voltage is applied to pin 3 of U302. When the strength of the signal that the transceiver is tuned to increases, the voltage at pin 2 of U302 decreases (goes more negative). This produces a higher positive voltage at the output (pin 6) of U302. As this voltage increases, D305 starts to conduct. This allows C317 to charge, resulting in a positive voltage being applied to pin 5 of 2nd IF amplifier U301; thus, the gain of U301 is reduced. R312 provides a discharge path for C317.

The amplified 8.83 MHz IF signal is coupled through C326 to the signal input (pin 4) of product detector U303. A signal from the BFO is coupled through C329 to the carrier input (pin 7) of U303. U303 mixes the two input signals and produces sum and difference signals at its output (pin 6). The sum frequency is filtered out by C334 through C336. The difference frequency is an audio signal.

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AUDIO CIRCUITS

After being filtered at the output of product detector U303, the audio signal is coupled to the inverting input (pin 6) of operational amplifier U304B. This stage makes up a low-pass filter with an approximate cutoff frequency of 1 kHz at the 6 dB point. The amplified audio signal at pin 7 of U304B is coupled through C347 to Selectivity switch SW3, and then through R352 and C339 to the input (pin 2 of U304A) of the audio-active filter.

In addition to U304A, U304C makes up the audio-active filter. These operational amplifier sections are cascaded and allow a certain amount of audio frequencies to pass through. The bandwidth for this filter is 300 Hz (between the 6dB points) at a center frequency of 700 Hz. This filter provides sharp selectivity and permits excellent rejection of unwanted, adjacent audio signals in the receive mode. The output of the audio-active filter is coupled through C346 to Selectivity switch SW3. The setting of this switch determines which signal is applied to AF Gain control R3.

The audio signal from the wiper arm of AF Gain control R3 is coupled through R369 to the input (pin 8) of audio power amplifier U306. A signal is coupled from the output (pin 8) of sidetone oscillator U304D to this input. In the transmit mode, Q303 mutes this input by connecting it to ground. The output signal from U306 is coupled through C359 to speaker J3 or phone jack J2.

KEYING CIRCUIT

Q407 through Q409 provide timing and switching of the receive and transmit functions in the Transceiver.

The keying circuit is made up of Q408 (+T transmit request) and Q409 (+R receive request). The outputs of these transistors are activated when the CW key is depressed. Q411 and Q412 in the receiver mute delay circuit are activated in the same manner.

When the key is depressed, the base of Q408 goes low. This causes it to conduct, thus establishing a

+12 volt output for the "+T" request lines. At the same time, Q407 conducts and turns off Q409. C574 through C577 provide the proper timing of these lines as they are turned on and off.

RECEIVER MUTING

Q411 and Q412 provide a variable delay for the receiver muting circuit. The emitter of Q411 is connected to ground when the key is being depressed. This effectively puts the collector of Q411 at ground potential, causing mute drive transistor Q412 to conduct and provide +12 volts. The muting of the receive line ceases when the base voltage of Q412 reaches the +B voltage. R445 and C578 provide an adjustable time constant for the muting circuit.

SIDE TONE

When the key is depressed, pin 9 of sidetone oscillator U304D goes high and the oscillator is activated. The 700 Hz signal at the output (pin 8) of U304D is coupled through C351 and applied across Sidetone Level control R368. From the wiper of R368, the sidetone is coupled to the input (pin 8) of audio amplifier U306.

RELATIVE POWER

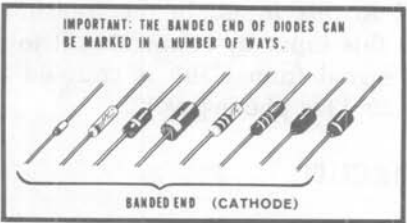
In the transmit mode, C568 couples a portion of the RF voltage across voltage divider R428 and R429. D408 rectifies the positive half cycle of the voltage across R429. C569 filters this positive voltage, which is coupled to meter M1 through current-limiting resistors R331 and R431.

S-METER



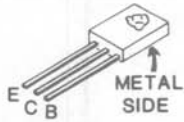
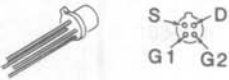


In the receive mode, D306 conducts when the AGC voltage across C317 exceeds a predetermined level. A portion of this voltage is coupled through R314 to the gate of Q302. The resulting, ramped voltage at the source of Q302 is coupled to meter M1 through current-limiting resistor R331. A regulated +9 volt supply powers the meter circuit. Meter zero control R333 allows you to set the meter to zero.

SEMICONDUCTOR IDENTIFICATION CHARTS

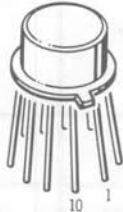
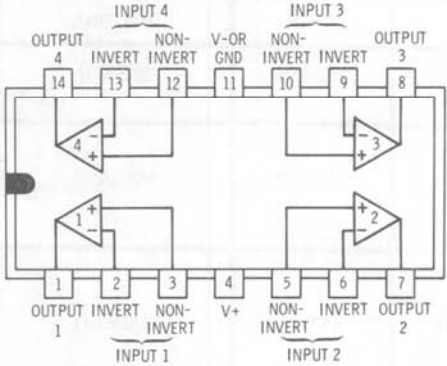
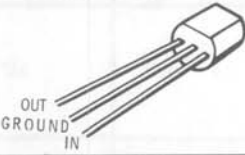
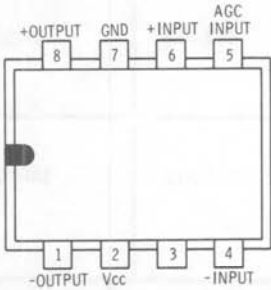
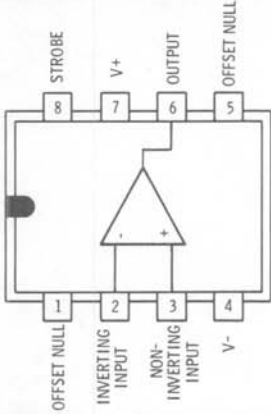
DIODES

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D307, D308, D309, D311	56-20	1N295A	 <p>IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.</p> <p>BANDED END (CATHODE)</p>
D119	56-24	1N458	
D138, D139	56-26	1N191	
D405	56-55	1N4753A	
D141, D142, D303, D305, D306, D312, D401, D402, D403, D404, D406, D407, D408	56-56	1N4149	
D101, D102, D103, D104, D107, D108, D112, D113, D121, D122, D123, D124, D127, D128, D132, D133, D143, D301, D302	56-646	BA-244	
D409	57-27	1N2071	
D118	57-65	1N4002	

TRANSISTORS

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q102, Q105, Q112, Q301, Q302	417-169	MPF105	
Q401, Q402	417-172	MPS6521	
Q407, Q412	417-201	X29A829	
Q106	417-234	2N3638A	
Q101, Q108 Q109, Q111	417-293	2N5770	
Q103, Q104, Q113, Q114, Q115, Q303, Q411	417-801	MPSA20	
Q408, Q409	417-819	MJE171	
Q107	417-863	MFE131	
Q404	417-205	2N3866	
Q405, Q406	417-912	MRF237	

INTEGRATED CIRCUITS (IC'S)

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION (TOP VIEW)
U303	442-96	MC1496G	
U304	442-602	LM324N	
U402	442-681	78L08	
U301	442-55	MC1349P	
U302	442-715	CA3130	

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION (TOP VIEW)
U306	442-763		

80 meters 3.75 MHz
 40 meters 7.25 MHz
 30 meters 10.25 MHz
 20 meters

Doubler Side

Q107

G1	^{Back} .24	.14
G2	2.3	1.8
D -	<u>.96</u>	.3

Q101

B	.13	.18
E		
TP101	<u>.48</u>	.28
E	<u>.48</u>	.28

Q107

G1 .14
G2 ~~1.8~~ 1.8
Prain .3

Q101

B .18
E ~~1.8~~ .28
TP101 .28

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least **THREE INCHES** of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



HEATH COMPANY • BENTON HARBOR, MICHIGAN
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.