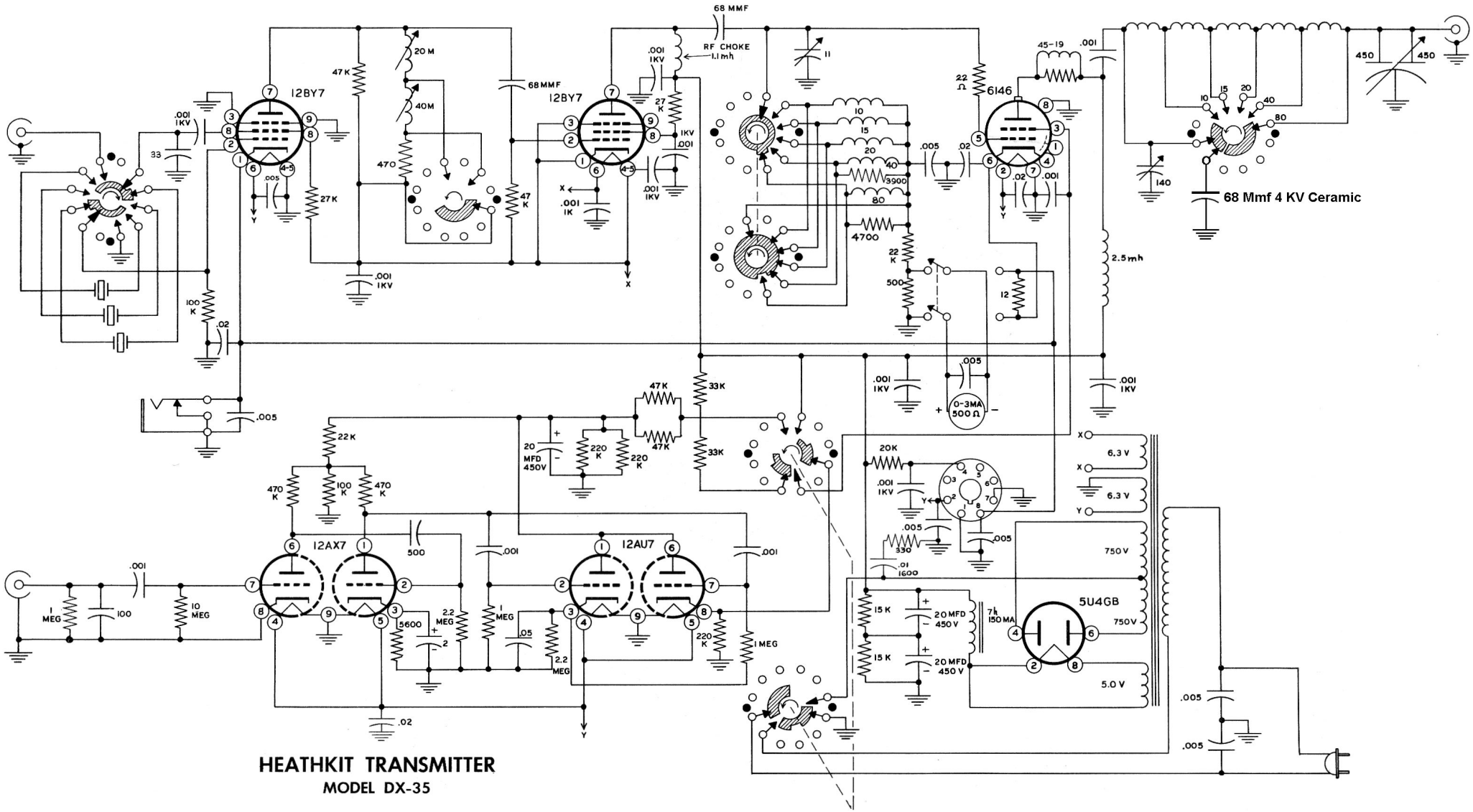
HEATHKIT AMATEUR TRANSMITTER

MODEL DX-35

SPECIFICATIONS

Power Input:	65 watt CW, 50 watt peak controlled carrier phone
Output Impedance:	50-1000 Ω
Output Coupling:	Pi network (coaxial)
Operation:	Crystal-VFO, CW, Phone
Band Coverage:	80, 40, 20, 15, 11, 10 meters
Tube Complement:	5U4GB Rectifier
	12AX7 Speech Amplifier
	12AU7 Carrier Control, Modulator
	12BY7 Crystal Oscillator
	12BY7 Buffer
	6146 Final Amplifier
Power Requirements:	115 volts AC, 60 cycles, 175 watts
Cabinet Size:	13" wide x 8 1/2" high x 9" deep
Net Weight:	21 lbs.
Shipping Weight:	26 lbs.



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SERVICE AND MAINTENANCE HINTS

The purpose of this pamphlet is to outline for those beginning in amateur radio some of the common problems that arise in servicing and operating a transmitter.

WARNING: Voltages dangerous to life are present at practically all points on the chassis. The Heath Company will not be responsible for injuries which could occur while making tests. Do not attempt to make voltage checks or service the transmitter without taking standard precautions and using the proper equipment. If in doubt, secure the assistance of a competent technician.

1. IMPORTANT -- Read list of errors that could damage your transmitter.

2. General Service Practices.

3. Analyzing and Isolating Difficulties.

4. Power Supply.

   Oscillator

   Buffer

   Final

   Modulator

5. Grid Drive -- See Oscillator and Buffer Sections.

6. Plate Current -- See final amplifier section and antenna considerations.

7. Meter circuit

8. Antenna Considerations and TVI.

COMMON ERRORS

LISTED BELOW are several of the common mistakes that can permanently damage components in your transmitter. Oftentimes while hunting for a minor difficulty in a transmitter, other components may be seriously damaged. This is caused by the high current in the final when it is not properly tuned.

1. Don't make voltage checks without proper safety precautions.

2. Don't turn the transmitter to CW or Phone unless you have an antenna or dummy load (60 w light bulb) connected, except to check no load dip.

3. Don't operate the transmitter without crystals installed or VFO tuned to the proper frequency. Be sure the crystal-VFO switch is turned to the proper position.

4. Don't leave the transmitter in operation over 5 minutes, even when testing. The duty cycle of the power supply is 5 minutes on and 10 minutes off. This, of course, refers to continuous operation and does not apply to CW or Phone operation. Phone or CW operation under normal operating conditions will not approach the maximum limit.

5. Don't cover the ventilation holes provided in the cabinet.

6. Don't test the oscillator, buffer or modulator stages with the final on if it is not dipped to resonance. Read the last paragraph in the General Service Instructions regarding the disabling of the final to protect the tube.

GENERAL SERVICE

SOLDERING: Cold solder connections, loose connections and unsoldered connections are the most common errors in assembling a transmitter. Check each and every connection and reheat and solder all that seem to be cold or improper. Reread the instructions on soldering in the construction manual. Many times when more than one wire is connected to a terminal or lug the lower wire will not receive enough heat and therefore can cause intermittent trouble when the wires near the top are properly soldered.

COMPONENTS: Any part that physically looks defective should be tested with the proper instrument.

TUBES: Tubes can be checked on a tube checker but the best method is by substitution. An extra set of tubes should be on hand for testing and to replace normal tube failures.

LEAD DRESS: Follow the construction manual and pictorials so that each lead is placed in its proper position. Make lead as short as possible, except where leads are specifically routed around the edge of the chassis. This will avoid shorting and grounding between components and chassis.

FINAL STAGE: The 6146 final tube can be damaged in a few minutes if the final is not tuned to resonance. If you wish to test other stages with the plate current on, disconnect screen lead from pin 3 on the 6146, and ground Pin #3 to chassis. This will enable you to operate the transmitter up to the final including the indication of grid current on the panel meter without any RF output. WARNING: High voltages will be present in the final. Use caution when making tests.

ANALYZING AND ISOLATION

The transmitter can be divided into stages. Each stage can then be isolated and worked on individually. In the next section, simple steps will be outlined to test each stage. A VTVM or multimeter is necessary to check voltages and resistance.

Voltages listed in this booklet were made with the Heathkit V-7A VTVM. The line voltage was 118 volts AC. The transmitter was tuned to 15 meters CW, crystal controlled for all checks except the modulator section. This was checked with the transmitter in 15 meter phone position with no modulation applied.

Voltages listed were found by averaging the results of a number of transmitters. Values listed do not necessarily indicate those in your transmitter. Line voltage variation, component tolerance and the presence of RF will cause variations. They should only serve as a basis of comparison. AC filament voltage may read high due to the presence of RF.

POWER SUPPLY

Read the last paragraph under General Service Instructions

TUBE E 5U4

1. Check the rectifier tube E.

2. Test the filters in the high voltage circuit by measuring resistance between pin 1 of tube E and the chassis. It should measure not less than 25K ohms in both the phone and CW position of the function switch. Lower resistance would indicate a short circuit in the B-plus circuit or a leaky or shorted filter capacitor.

3. Check the function switch for open contacts, or solder run into contacts.

4. Test the transformer by removing the rectifier tube E and measuring the AC voltages. Voltage between the yellow leads should read approximately 5 volts. The red leads between 700 and 800 volts each side of the center tap. The center tap is the yellow and red lead. Both filament windings should read approximately 6.3 volts AC. Green leads are winding #1 and yellow leads are winding #2.

5. Check each 10 watt 15 K ohm resistor. They should be of equal resistance plus 10%. Unbalanced resistors would place an extra heavy load on one of the filter capacitors.

6. Inspect the filter capacitors and see that they are polarized properly. If not, they should be replaced.

Voltage checks -- Tube E in socket.

Pin	1	2	3	4	5	6	7	8
	650 DC	675 DC	0	925 AC	0	925 AC	0	675 DC

OSCILLATOR STAGE

Read the last paragraph under General Service Instructions

TUBE D -- 12BY7

1. Test tube D 12BY7.

2. Check the crystal switch. Make sure the switch is turned to the proper crystal or VFO position.

3. Test the crystal you are using by substituting other crystals.

4. Voltage of approximately 300 volts DC at terminal strip EE will indicate stages operating properly.

5. Check the 40 meter and the 20 meter coils for open windings.

6. Be sure the switch wafer on the band switch is mounted properly and not 180 degrees out of step with the other wafers. This could have been mounted wrong during assembly.

Voltage Checks -- Tube D

Pin	1	2	3	4	5	6	7	8	9
	0	-27 DC	0	0	0	6.3 AC	350 DC	200 DC	0

BUFFER STAGE

Read the last paragraph under General Service Instructions

TUBE C 12BY7

1. Check tube C 12BY7.

2. Inspect the rotary switch contacts. They are the two wafers in the center of the band switch. Be sure there is no solder on contacts and that each is making a good electrical connection with the rotor.

3. Inspect the buffer coils. Check each coil for a broken winding or an open coil. Make sure the coils have not been interchanged.

4. High voltage will be present on the filament and cathode. (Pins 1, 4, 5 & 6.) This tube operates in series with the oscillator tube.

5. Test the RF choke between pin 7 and terminal strip DD1 for an open winding.

6. High grid drive can be corrected by reducing the value of the resistor across the 40 or 80 meter buffer coil. Example -- The 80 meter coil has a 4700 ohm 1 watt resistor placed across it. It can be reduced to 3300 or even 2200 ohms 1 watt, to lower the grid drive to approximately 2¼ m.a. which is best for optimum performance. At no time should the grid drive exceed 3 m.a.

Voltage Checks -- Tube C

Pin	1	2	3	4	5	6	7	8	9
	340 DC	120 DC	340 DC	340 DC	340 DC	335 DC	620 DC	500 DC	330 L

Voltages listed above have been checked from the terminal to the chassis. Read the filament voltage on this tube between pin 4 or 5 and pin 6. It should be approximately 6.3 volts AC. The actual voltage across this tube can be measured from pin 7, the plate, to pin 1, the cathode.

MODULATOR STAGE

TUBE A -- 12AX7

TUBE B -- 12AU7

1. Test the 12AX7 and the 12AU7
2. Test the 20 mfd. and the 2 mfd. electrolytic condensers.
3. Inspect the tube sockets for poor solder connections.

OSCILLATION in the modulator section can be caused by the feed back of RF through the mocrophone circuit. Install a 1.1 mh RF choke in the mocrophone lead at the Amphenol connector.

Voltage Checks -- Tubes A and B

Pin	1	2	3	4	5	6	7	8	9
12AX7	160	0	1.8	6.3 AC	6.3 AC	95	-.8	0	0
12AU7	425	0	36	6.3 AC	6.3 AC	420	35	60	0

METER CIRCUIT

High currents in the final circuit due to improper loading or tuning of the transmitter will overload the meter and meter shunting resistor.

The 0-3 ma. meter used in the DX-35 is the vane type meter and its movement during the operation of the transmitter on CW will not harm the meter. It is best to leave the meter in the grid position while keying.

FINAL AMPLIFIER

TUBE F 6146

1. Test the tube 6146

2. Grid drive should be between 2 and 3 ma. for proper operation.

3. Check the final choke by the use of an ohm meter.

4. Tighten the nuts on the feed-thru insulators. (Top and bottom).

5. Inspect the antenna tuning condenser and the final Amplifier condenser for shorts.

6. Check the 68mmf Capacitor between the band switch terminal A8 and terminal strip KK-1.

7. Inspect the connections of the final tank coil to the band switch. Make sure each is connected to the proper terminal on the switch.

GRID DRIVE to the final amplifier stage is essential. It should not be on for more than a few seconds if no grid drive is indicated on the panel meter.

DRIVE CONTROL will have little or no effect on Grid current in the 80 meter and 40 meter bands.

LOADING the transmitter on 80 and 40 meters will be difficult if the 68mmf condenser is shorted or open. This condenser is not in the circuit on the other bands.

KEYING is accomplished by grounding the cathode of the Final Amplifier and the Oscillator stage. Poor solder connections in this circuit will cause intermittant keying.

DIPPING the final is accomplished by tuning the stage to resonance. If the dip is too low on the plate meter and it is impossible to load it with the Antenna Tuning Condenser, the antenna should be checked. This is also true if it will not dip at all. The easiest test for this condition is to substitute a dummy load, (60 w bulb) for the antenna.

CREEPING PLATE CURRENT will usually indicate a soft final tube. Loss of grid drive usually accompanies this condition.

Voltage checks -- Tube F

Pin	1	2	3	4	5	6	7	8	9
CW	1.3 DC	6.3 AC	150	1.3 DC	-55	1.3 DC	0	0	675
Phone	.5 DC	6.3 AC	70	.5 DC	-70	.5 DC	0	0	675

ANTENNA

The pi network will eliminate the need for a separate antenna coupler when properly used.

The pi network has definite limitations regarding both the impedance and reactance that it can handle. It is possible to load high impedance but is preferable to use low impedance which will reduce the voltage and radiation from the feeders. Feeding a doublet antenna with 72 ohm coax is an example of a low impedance match.

Loading the transmitter to an improper antenna will cause high voltages and currents to flow in the tank circuit. This will damage the final tube, loading capacitor, and even the final tank coil.

The Heath Company would rather not make recommendations as to the kind of antenna you should use. There are many that will work and each has its own characteristics. In general, a tuned antenna fed with untuned feeders can be connected directly to the transmitter. The antenna should be cut to one half wave length and fed in the center with 50 or 72 ohm coax.

A folded dipole type of antenna can be used if it is cut to one half wave length of the operating frequency, and fed with tuned lines. However, Balun coils would have to be used.

The long wire type of antenna is considered high impedance when end fed. For best results, it should be equal to one half wave length of the lowest operating frequency and connected to the transmitter through a suitable antenna coupler.

The Windom type of antenna has several variations and in general is not recommended to be used on the DX-35 transmitter.

Additional information on antennas can be found in:

Radio Amateurs Handbook	ARRL
The Antenna Handbook	ARRL
The Antenna Manual	Editors and Engineers, Ltd.
The Beam Antenna Handbook	Radio Publications

Harmonics radiation in most cases has been traced to an improper antenna or an incorrectly loaded antenna. Be sure your final stage is dipped to the proper point of resonance. A strong second harmonic can usually be corrected by the use of an antenna that is not resonant to the second harmonic. The folded dipole cut to a one half wave length of the operating frequency and fed through Balun coils will usually correct this condition.