

Heathkit IG-18 THD Modification Manual

There have been lots of articles regarding the improvement of the Heathkit IG-18, but none of them have ever offered a complete kit to make these modifications for the DIY'er. After much urging from my customers, I am now offering a complete kit to upgrade the Heathkit IG-18 based on the many articles that I have been able to review. This kit can be implemented for less than \$50 by doing it yourself. This same upgrade can be performed on the IG-5218, SG-18, and the SG-5218. You may note that some of the parts changes may have already been incorporated into your kit by Heathkit, depending on when your particular model was sold. Specifically, the changes to R3 and C5 were incorporated into the IG-5218, and possibly some later versions of the IG-18. The Meter Buffer Board was never incorporated into any of these models. The Meter Buffer Board plays an important role in isolating the meter rectifier diodes from the output signal path. Because of the non-linear loading of these diodes, harmonics can be created in the analog signal path that will affect the THD of the final output.

It seems there is some controversy over the meter damping circuit (R7 & D1). In some cases this combination of parts have been reported to improve the meter accuracy. In other cases there is no effect. These two parts were originally proposed by Reg Williamson's in his article 'The Greening of the IG18' published in the Audio Amateur magazine in 1971. There were other modifications that have also been challenged which seem to have little or no effect on the overall THD specification. I have yet to find a unit where this particular change improved the accuracy of the meter. It's your decision to install these parts or not.

We have incorporated the changes that have been verified to improve the THD of the generator. We have left out the changes that are controversial and/or require major 'hacks' to the PC board. We are of the opinion that any modification must have a major impact to the kit, to justify 'hacking' the PC board.

Assembly of the IG-18 Meter Board

See Appendix 1 for help identifying the various parts to be installed.

() Install 3 Diodes (observe the polarity of the cathode lead marked with a contrasting band. Match to the band on the board

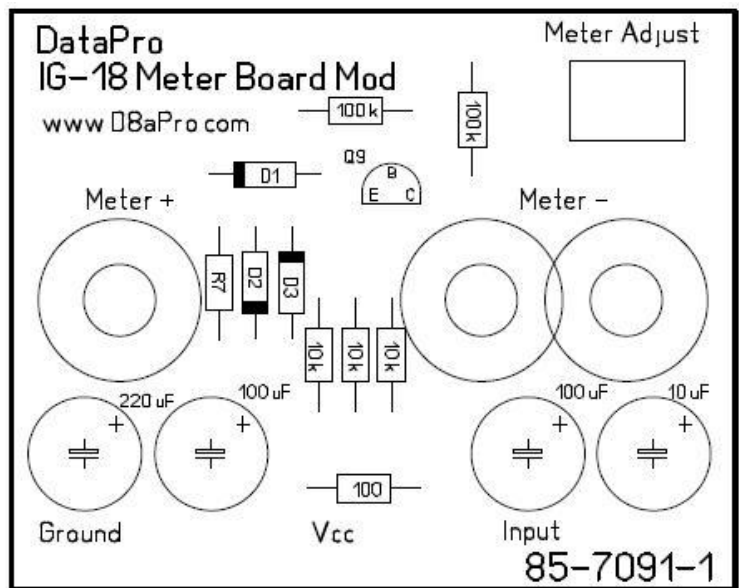
() Install 5600 Resistor (R7 see text)

() Install 3, 10k Resistors

() Install 2, 100k Resistors

() Install 100Ω Resistor

() Solder and trim leads



Meter Board Silkscreen with parts layout

() Install Transistor (match the outline to ensure the correct pins are in the correct holes).
Solder and trim leads

() Install Meter Adjust pot in either set of holes (Top or Bottom)

() Install 2 - 100 μ F Caps (make sure the orientation of the plus or minus lead matches the outline drawing)

() Install the 220 μ F cap

() Install the 10 μ F cap

() Solder and trim the leads

() Connect the 3-wire cable to the meter board and log the colors used:

Ground = _____

Vcc = _____

Input = _____

Set the assembled board aside to be used later

Changes to Stock IG-18

Before we start, let me say a few words about modifications. If the IG-18 that you intend to modify is not working, the odds are that it will still not be working after you've made these modifications. In addition, these modifications will only add to the number of variables when trying to troubleshoot the unit. It is therefore very important that you have the unit to be modified fully operational before making these changes.

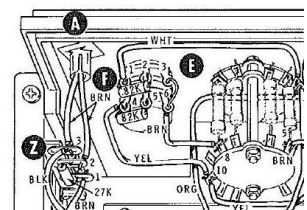
Also, some of these modifications had been adopted by Heathkit at various times throughout the life of the IG-18, so it is quite possible that some of these may already exist in your generator. Check each component carefully. If it has already been changed to the new value, there is no reason to replace that component. Let's begin...

() Temporarily remove the wire that is connected to the control mounted at location "F" on pins 3 and 6. This is typically a 'Brown' wire.

() Place the control in the CCW position ("0" position)

() With an Ohmmeter, measure the resistance between pins 1 and 3, and 4 and 6. This measurement should be an 'Open' circuit.

If it is not, continue on to the next step, otherwise, reconnect pin 1 and 3 then skip on to 'Replacements'.

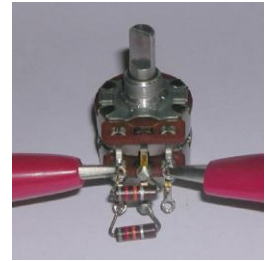


Control at Location 'F'

Variable Frequency Control Modification

When the variable frequency control for the 'Units' is in the '0' position, it must be completely out of the circuit. This is accomplished by breaking the circuit on the internal carbon ring near the '0' position.

- () Remove the wire connected to Pin 1
- () Remove the wire connected to Pin4
- () Remove the control located at location "F"
- () Carefully open the control by gently prying up the tabs at the front of the control
- () Remove the first control wafer and, using an Exacto knife, cut the carbon ribbon near the CCW position
- () Gently pry open the control area directly behind the 1st control area
- () Remove the second control wafer and, using an Exacto knife, cut the carbon ribbon near the CCW position on this one also
- () Measure both control ribbons with an Ohmmeter to ensure that the carbon ribbon is indeed open near the CCW position
- () Re-assemble the control and re-install it at position "F"
- () Re-connect the wires removed from Pins, 1, 4, and 3 & 6

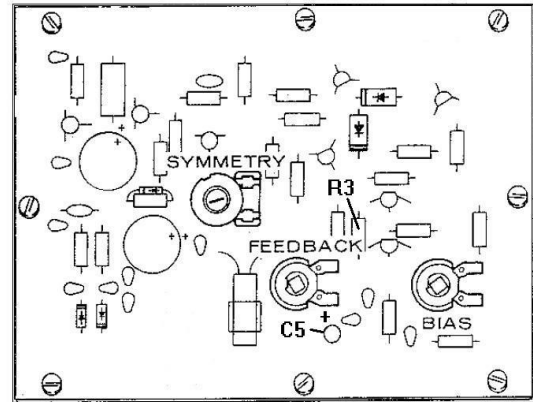


Replacements

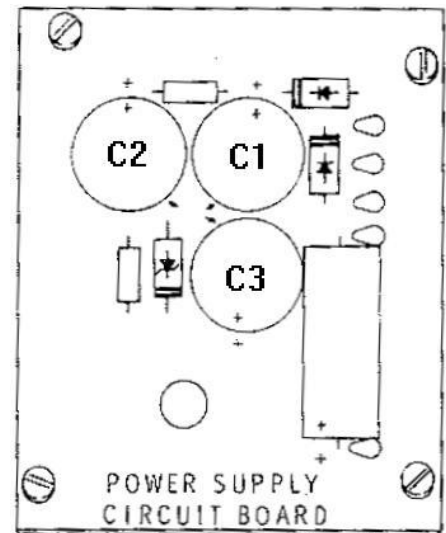
- () Replace Resistor R3 on the Wave Generator Board with a 56k
- () Replace Capacitor C5 on the Wave Generator Board with a 100 μ F Observe the correct Polarity
- () Replace Capacitor C1 on the Power Supply Board with a 1000 μ F Observe the correct Polarity
- () Replace Capacitor C2 on the Power Supply Board with a 1000 μ F Observe the correct Polarity
- () Replace Capacitor C3 on the Power Supply Board with a 470 μ F Observe the correct Polarity

Replace existing Meter Circuit

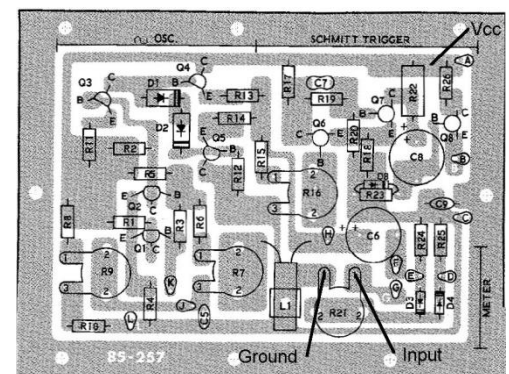
- () Remove the wires connected to the meter by removing the nuts holding the connectors in place
- () Remove the same wires from the circuit board, these will not be used
- () Remove control R21 from the circuit board, this will not be used
- () Mount the previously assembled Meter Circuit board to the back side of the meter using the nuts removed from the original wires. Make sure that the “+” hole of the board goes to the “+” on the meter. There are two sets of holes to accommodate two different size meters.
- () Route the 3-wire cable into the bottom of the IG-18 near the meter
- () Connect the 3-wire cable as shown on the ‘Solder’ Side of the Wave Generator Board using your logged colors from the assembly of the meter board
- () Set the meter control on the meter board to the “mid” position



Wave Generator Board viewed from Top side



Power Supply Board viewed from Top side



Meter Board Connections to Wave Board on 'Solder' side of Wave Board Note: R21 has been removed

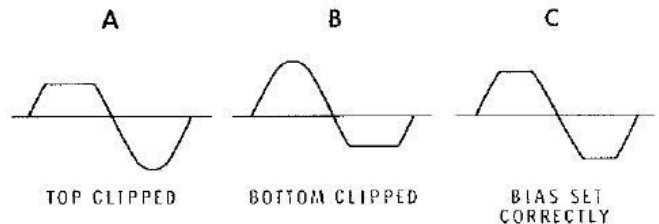
Testing and Adjustments

- () Connect the Sine Wave Output to a scope
- () Set the Multiplier to X100
- () Set the Ten's Frequency Switch to 10
- () Set the Unit's Frequency Switch to 0
- () Set the Frequency Control (Pot) to 0
- () Set the 600 Load to 'Int'
- () Set the Coarse Sine Wave Amplitude to 1
- () Set the Fine Sine Wave Amplitude to 'Mid'
- () Set the Coarse Square Wave Amplitude to .1
- () Set the Fine Square Wave Amplitude to full 'CCW'
- () Turn the unit on

There should be a signal of approximately 1000 Hertz displayed on the scope and some indication of output on the meter. If not, go back over the modifications and check for poor solder connections or misplaced components. Assuming that the unit was working before the modifications, it should be working now.

- () Adjust the 'Feedback' control so that you can see distortion at both the top and bottom of the waveform.

- () Now adjust the 'Bias' control so that the same amount of clipping takes place on both the top and bottom of the waveform. You may need to back the 'Feedback' off a bit if it is too high.



- () Next adjust the 'Feedback' control to remove the distortion at the top and bottom of the display. You will need to adjust the control between the visible distortion and the point where the waveform starts to 'bounce'. There is a 'trade-off' point between the lowest possible THD distortion and the ability of the IG-18 to oscillate. Find the point where the IG-18 will operate on all ranges but the feedback is at its maximum. This is the point of minimum THD distortion.

- () Connect the IG-18 to an Audio AC Meter (If an AC Voltmeter is not available, simply read the output on the scope)

- () Adjust the Fine Sinewave Amplitude for a 1 Volt RMS reading on the AC Voltmeter (or 2.83 Volts Peak-to-Peak on the scope)

- () Using the Meter Adjust control on the new Meter Board, adjust the reading of the meter to indicate 1 Volt RMS

() This completes the IM-18 Distortion Mod

THD Measurement

We are currently working on a small PC board that will allow you to determine the approximate THD measurement of your newly modified IG-18. This board should be available in a couple of months. Please watch our listings on eBay for when these will become available.

Appendix 1

IG-18 Component Replacements

C1 – 1000 μ F 63 VDC Electrolytic Capacitor

C2 – 1000 μ F 63 VDC Electrolytic Capacitor

C3 – 470 μ F 63 VDC Electrolytic Capacitor

R1 – 56k (Green, Blue, Orange) $\frac{1}{2}$ Watt Resistor (Larger than the others)

C5 – 100 μ F 50 VDC Electrolytic Capacitor

Meter Board Components

D1 – D3 1N270 Germanium Diode

R1 – Meter Control 10k Potentiometer

R2 – 100 Ω (Brown, Black, Brown) $\frac{1}{4}$ Watt Resistor

R3 – R4 100K (Brown, Black, Yellow) $\frac{1}{4}$ Watt Resistor

R5, R6, R8 10K (Brown, Black, Orange) $\frac{1}{4}$ Watt Resistor

R7 – 5600 Ω (Green, Blue, Red) $\frac{1}{4}$ Watt Resistor (*Optional See Text)

Q9 – 417-801 MPSA20 Transistor

C1 – 10 μ F Electrolytic Capacitor

C2 – C3 100 μ F Electrolytic Capacitor

C4 – 220 μ F Electrolytic Capacitor

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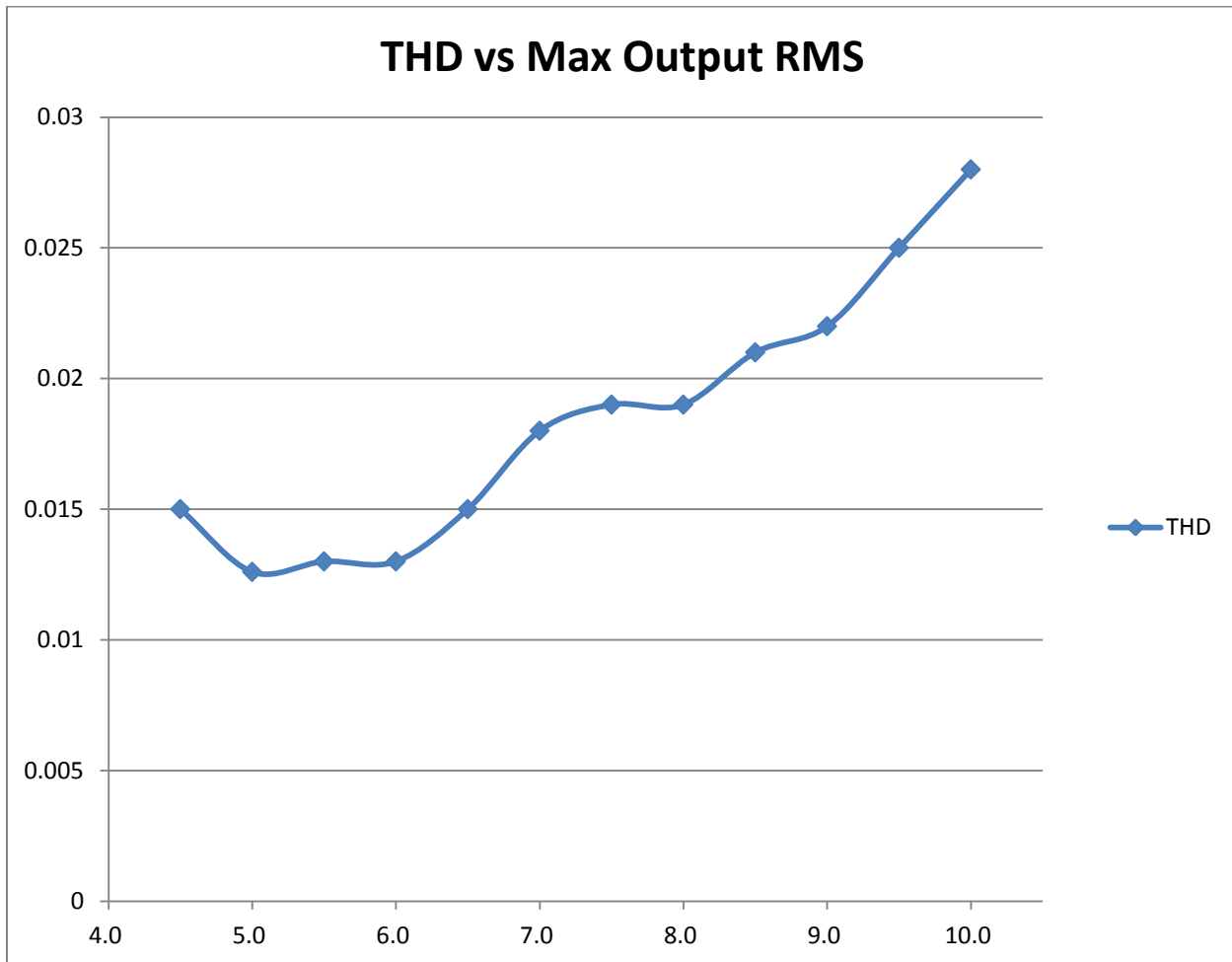
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Appendix 2

Max Output (RMS) vs. THD

Increasing the amount of negative feedback reduces the THD, but it ultimately affects the total maximum signal output Voltage.

The amount of negative feedback in the IG-18 oscillator can have a pronounced affect on the THD specification. We have measured several IG-18's and their derivatives to come up with the following chart.



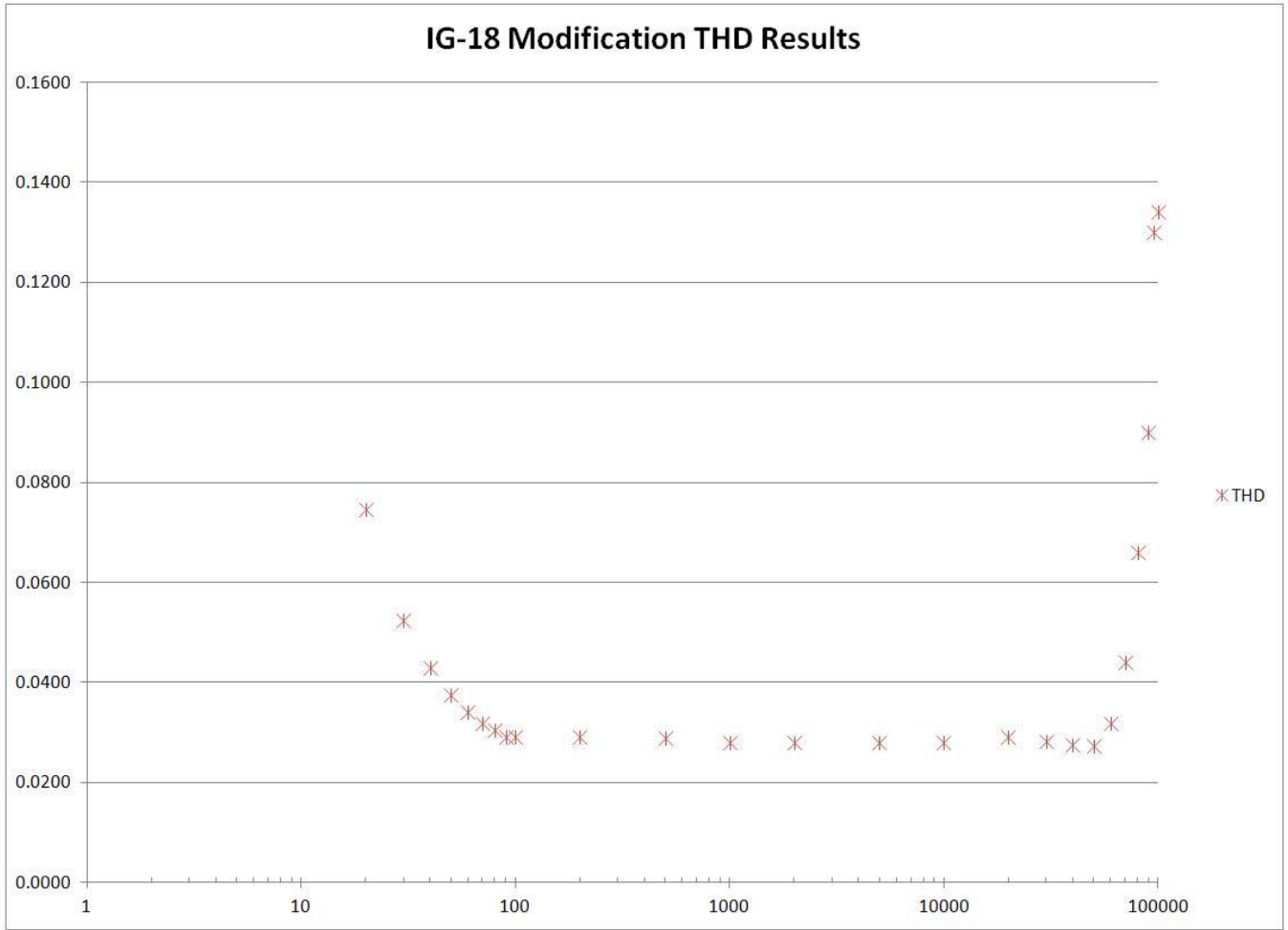
Max Output Voltage (RMS) vs. THD Measured at 1 kHz

The ideal spot seems to be right around 8.0 Volts RMS. This gives a still reasonable amount of max output Voltage, but reduces the THD specification to below 0.02% THD. You can use the above chart to determine the best operating performance for your particular application.

This is measured with the output attenuator and 'Fine' adjustment set to maximum. Erratic performance (bouncing) seems to start around 7.0 V rms and below.

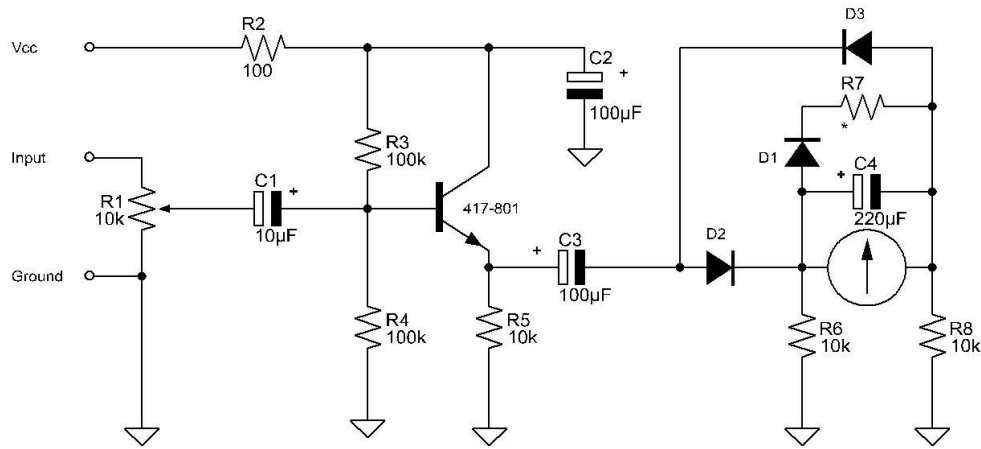
Appendix 3

Typical IG-18 THD vs. Frequency



Appendix 4

Meter Board Schematic



* R7 and D1 may have some affect on the meter linearity. Optionally used by the user.

Revision 1: January 16, 2013