



The Greening of the IG-18

In which one of our redoubtable English cousins does a Professor Higgins on Heath's metered sine-square oscillator and turns an Eliza Doolittle into a lady of ravishing style and performance.

HOW WOULD YOU like to own a genuinely high grade sine and square wave audio generator? Just look at these specifications:

RANGE: 1 Hz - 100KHz sine or sq.

RISE TIME: 12 nanoseconds

T.H.D.: 0-01%; typically, 0-002-0-005%

ACCURACY: better than $\pm 0.5\%$

AMPLITUDE STABILITY: ± 1 dB.

Yes, I can hear you say, and where do I rustle up the \$400 or more for what is obviously a laboratory standard instrument? Well, you lucky Audio Amateur subscriber, read on, for you can be the proud owner of an instrument in this class and for a bare fraction of that price tag.

One of my professional tasks is evaluation of new products for the most popular of English audio magazines *Hi-Fi News*. Last year, I had the good fortune to undertake a review of the new Heathkit model IG-18 audio generator. This transistor version of their popular tubed model IG-72 has identical performance and ranges, but also includes a square wave section.

Heath's specifications of the new model are modest, with a claim for less than 0.1% distortion, $\pm 0.5\%$ frequency accuracy and a square wave

By REGINALD WILLIAMSON

rise time of better than 50 nanoseconds. In fact, a tolerably good performance for something aimed at the service shop or the not-so-critical amateur. The kit had a couple of errors when I came to check it out, but these were corrected with the willing cooperation of the British company. (I'll be mentioning these later on.)

In my subsequent appraisal of the product, therefore, I was pleased to give it a warm welcome, with a mild qualification about its total harmonic distortion which it barely met.

What about my warranty?

Later, however, while idly studying the schematic, I began to realize Heath had given us a laboratory standard instrument in embryo, since the basic circuit design philosophy was sound and needed just a few refinements here and there, to bring about quite a startling performance improvement.

To begin, you will need a Heath IG-18 audio generator kit costing \$67.50. One word of warning, how-

ever. Quite rightly, our friends in Boston Harbor are perfectly entitled to invalidate their warranty if the owner makes unauthorized changes in their kit. Their excellent construction manuals usually make this quite clear. So first, you should build the kit as the manual directs and get it working exactly as they specify. In this way you can be sure the kit is free of basic flaws before making changes in it.

If subsequent to modifying the kit, you have trouble and want to return it to Heath, then you must be prepared to remove the modifications I shall be describing. On the other hand, I'm prepared to give assistance to any Audio Amateur reader who may write to me in care of the magazine.

How these oscillators work

The IG-18, in common with most audio signal generators in use today, is a resistance/capacitance (RC) type, which means the frequency of oscillation is determined by sharply frequency selective resistance/capacitance networks. Sometimes, the networks are in the bridge form, as in the so-called Wein Bridge oscillators; or, as in the case of the IG-18, the frequency determining elements are in a "bridged T" configuration.

This network type simulates a broadly tuned resonant circuit, and in the IG-18 is inserted in the degenerative, or negative feedback path of a high gain amplifier. Negative feedback is at a maximum, except at its "notch" frequency--so if oscillation occurs, it can only be at this frequency. So by simply altering the values of R or C, the frequency of oscillation is determined very accurately, to a tolerance defined by the accuracy of the bridge components. What small errors that do occur, could be caused by phase shifts within the amplifier; so this must be designed carefully and have a bandwidth well beyond the generator's frequency coverage.

The operational amp and loops

Heath's designers have come up with what is essentially, a very high gain operational amplifier, with low output impedance and two inputs, non-inverting and inverting. The RC bridge is in the inverting (or degenerative) path; the non-inverting path is the main regenerative loop and is also the amplitude controlling network. (See Fig.1)

I should explain at this point, that because of the low "Q" of RC tuned networks, it is essential to include them in an active filter configuration to insure low harmon-

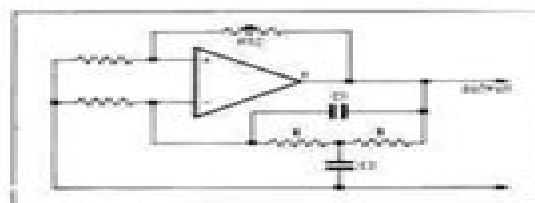


FIG.1. Simplified schematic of the operational amplifier Heath used in the IG-18 design. The triangle is the amplifier; its - input the inverting, the + the non-inverting.

Heathkit Ig 18 Manual

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Table of Contents Heathkit Ig 18 Manual

1. Understanding the eBook Heathkit Ig 18 Manual
 - The Rise of Digital Reading Heathkit Ig 18 Manual
 - Advantages of eBooks Over Traditional Books
2. Identifying Heathkit Ig 18 Manual
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Heathkit Ig 18 Manual
 - User-Friendly Interface
4. Exploring eBook Recommendations from Heathkit Ig 18 Manual
 - Personalized Recommendations
 - Heathkit Ig 18 Manual User Reviews and Ratings
 - Heathkit Ig 18 Manual and Bestseller Lists
5. Accessing Heathkit Ig 18 Manual Free and Paid eBooks
 - Heathkit Ig 18 Manual Public Domain eBooks
 - Heathkit Ig 18 Manual eBook Subscription Services

- Heathkit Ig 18 Manual Budget-Friendly Options
- 6. Navigating Heathkit Ig 18 Manual eBook Formats
 - ePub, PDF, MOBI, and More
 - Heathkit Ig 18 Manual Compatibility with Devices
 - Heathkit Ig 18 Manual Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Heathkit Ig 18 Manual
 - Highlighting and Note-Taking Heathkit Ig 18 Manual
 - Interactive Elements Heathkit Ig 18 Manual
- 8. Staying Engaged with Heathkit Ig 18 Manual
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Heathkit Ig 18 Manual
- 9. Balancing eBooks and Physical Books Heathkit Ig 18 Manual
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Heathkit Ig 18 Manual
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Heathkit Ig 18 Manual
 - Setting Reading Goals Heathkit Ig 18 Manual
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Heathkit Ig 18 Manual
 - Fact-Checking eBook Content of Heathkit Ig 18 Manual
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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