Design Project: Signal generator

Your project is to design and build a signal generator, using an integrated circuit dedicated to this purpose. I recommend using either the Harris 8038 or the Maxim MAX038CPP. Complete schematic diagrams for signal generator circuits may be found on the respective datasheets for these devices.

The signal generator must be powered by AC from the line, so it needs to have its own regulated AC-DC power supply! Signal frequency and amplitude must be independently adjustable, ideally with "coarse" and "fine" adjustments for frequency. Your circuit must be able to output sine, square, and triangle wave signals, either selectable or simultaneous outputs.

Deadlines (set by instructor):

- Project design completed:
- Components purchased:
- Working prototype:
- Finished system:
- Full documentation:

Question 1

Explain the principle of operation for the particular integrated circuit you are using in your signal generator device. How does it function, internally? Explain how it produces each of the following waveshapes:

- Triangle wave
- Square wave
- Sine wave

file 01513

Answer 1

Answers to this question vary, of course, with the integrated circuit you are using.

Notes 1

This question provides an excellent opportunity for students to research their chips' datasheets, and to comprehend what engineers have written there.

Question 2

Explain how frequency is adjusted in your signal generator circuit. Your circuit should contain both a "coarse" and a "fine" adjustment (the coarse adjustment could be a multi-position switch, to select different frequency ranges).

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Answer 2

Frequency adjustment is usually accomplished by means of a resistor/capacitor network. What I'm looking for here is a detailed explanation of how this network functions to control the frequency of oscillation. To answer this, of course, you must have a firm understanding of how the signal generator IC works internally.

Notes 2

Students should be able to find this information in their chips' datasheet(s).

Question 3

What provisions are provided on the integrated circuit for adjusting the distortion of the sine wave output? Explain how you would determine when the sine wave output was properly adjusted (for minimal distortion). What test equipment would be ideal to use for this purpose, and how would that test equipment be set up on your circuit?

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Answer 3

Although an oscilloscope could be used to make coarse adjustments, the best instrument by far for this purpose would be a *spectrum analyzer*.

Notes 3

Professional-quality spectrum analyzers may not exist in your lab, but do not worry. There are several high-quality devices built to interface with a personal computer that are capable of displaying spectrum analyses. If all you care about is low frequency (audio range) analysis, you can even get away with using a personal computer sound card (with the appropriate software) as the analysis device.

Question 4

Suppose you needed to boost the power output of your signal generator to 10 watts. This is substantially more than what the integrated circuit is capable of delivering unassisted. What else would you have to add to your circuit in order to obtain this level of power output? What difference(s) will it make to your design if you only intend to operate at audio frequencies, versus if you intend to sweep from audio frequencies all the way up to IF or even RF?

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Answer 4

Obviously, you will need some form of amplifier to "follow up" the signal generator IC. The real question is, what type of amplifier? There are many factors to consider here!

Notes 4

Students will have to consider several different factors when choosing an appropriate amplifier for the task, bandwidth being just one of them. Adding an amplifier stage to the signal generator circuit is a very appropriate design objective to include in this project, by the way!