

Frequency discriminator has ultra-sharp response

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Most rudimentary circuits for discriminating between two frequencies or two bands of frequencies sacrifice selectivity to simplicity. But this simple circuit, which uses just a frequency-to-voltage converter and a couple of general-purpose comparators, can differentiate between two frequencies separated by only a few hertz.

In this application, the circuit rejects all frequencies below 2.1 kilohertz, while passing others, although it is a simple matter to modify the discriminator to handle signals at any frequency. Input signals are introduced into the LM311 comparator (A_1), which operates as a zero-crossing detector. Its output is then applied to one input of a dual NAND gate and A_2 , the LM2917 frequency-to-voltage converter.

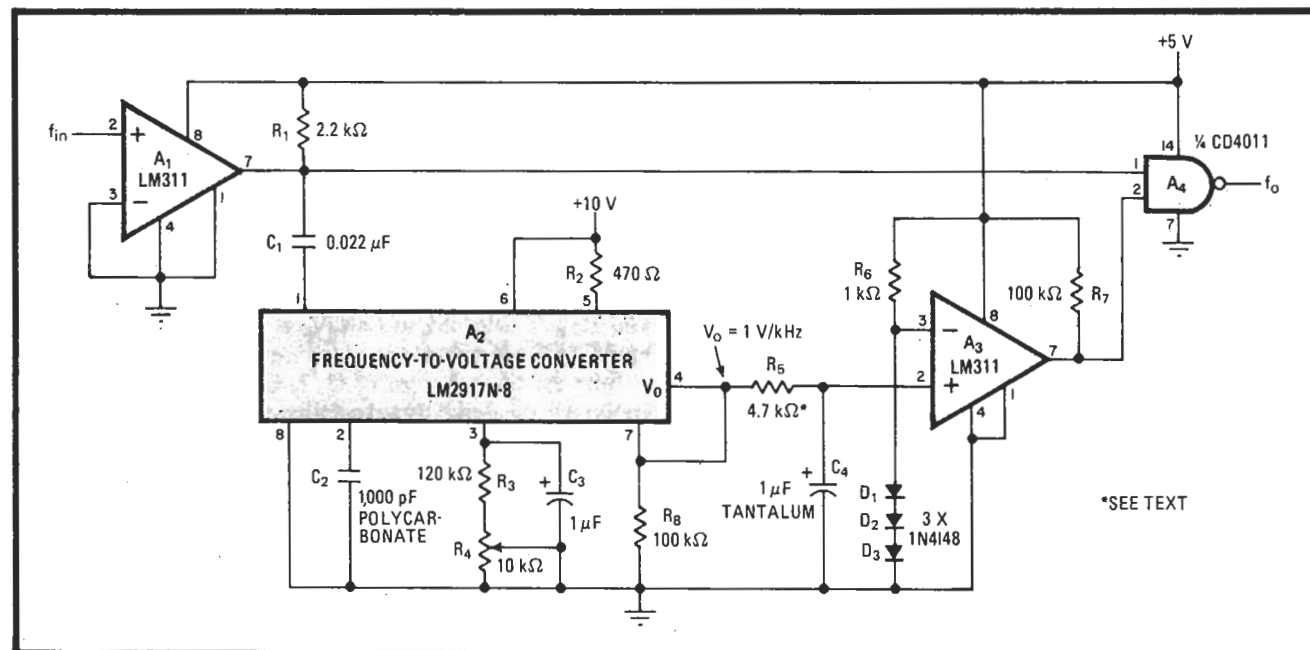
The converter, which drives the noninverting input of comparator A_3 , generates an output of one volt for each

kilohertz applied at its input. Thus, when f_{in} is less than 2.1 kHz, the output of the converter is less than 2.1 volts, and A_3 (whose noninverting input is biased at 2.1 V by diodes D_1 - D_3) is low. Therefore, output gate A_4 is disabled. If f_{in} moves above 2.1 kHz, A_3 will go high and enable A_4 , thereby permitting f_{in} to appear at the output.

The sharpness of the cutoff, which is determined by the transfer function of A_3 , is approximately 1 Hz. The response time of the circuit is adjusted by C_3 and R_5C_4 . These components act to control the integration time at the output, ensuring that a steady dc voltage is attained after a nominal number of periods of f_{in} . If a fast response time is desired, R_5 and C_4 should be deleted.

The circuit is made to handle signals at any frequency by applying a variable control voltage at pin 3 of A_3 , in lieu of the D_1 - D_3 and R_6 combination. And the discriminator can be used in other modes, to reject high frequencies, for example, or as a bandpass discriminator.

The discriminator that rejects high frequencies may be realized by simply reversing the inputs to A_3 . For bandpass applications, A_3 is replaced by a dual comparator, where the low- and high-cutoff frequencies are set by control voltages on the inverting and noninverting inputs of the comparators, respectively. A_4 must then be replaced with a triple-input NAND gate. □



Cycle cutoff. Frequency-to-voltage converter and comparators combine simplicity and selectivity in this frequency discriminator. Transfer function of LM311 determines sharpness of cutoff, in this case being 1 hertz. Circuit can be made to handle signals at any frequency if variable voltage is introduced at pin 3 of A_3 . Discriminator, configured in high-pass mode, can easily be modified for low-pass or bandpass duties.