Laboratory Application Assignment

In this lab application assignment you will examine an *RC* coupling circuit and an *RC* low-pass filter. In the *RC* coupling circuit you will see how the series capacitor blocks the dc component of the input voltage but passes the ac component. In the *RC* low-pass filter you will see how the low frequencies are passed from input to output with little or no attenuation but the higher frequencies are severely attenuated or blocked.

Equipment: Obtain the following items from your instructor.

- Function generator
- Oscilloscope
- DMM
- 0.1-μF and 0.22-μF capacitors
- 2.2-kΩ and 10-kΩ carbon-film resistors

RC Coupling Circuit

Examine the *RC* coupling circuit in Fig. 26–43*a*. Notice the input voltage is a pulsating dc voltage whose value remains entirely positive. The input waveform (across terminals 1 and 2) is shown in Fig. 26–43*b*. The output from the *RC* coupling circuit is taken across terminals 3 and 4, which is across the resistor, *R*.

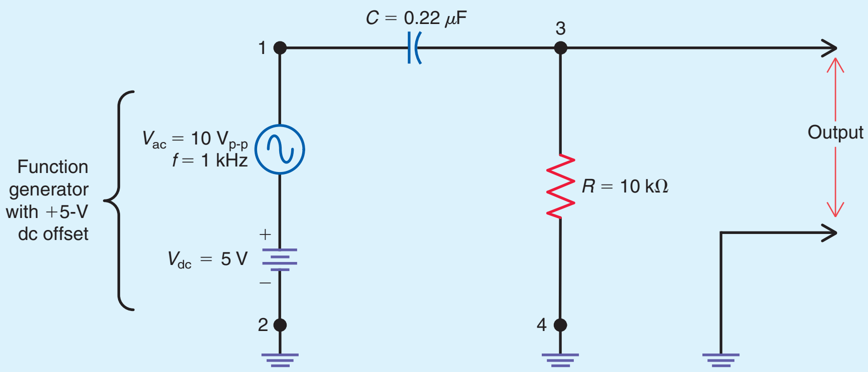
What value of dc voltage would you expect to measure across input terminals 1 and 2? $V_{in(dc)}$ = ___________

What value of rms voltage would you expect to measure across input terminals 1 and 2? $V_{in(rms)}$ = ___________
How much dc voltage would you expect to measure across the capacitor, *C*? $V_{C(dc)}$ = ___________
How much dc voltage would you expect to measure across the resistor, *R*? $V_{R(dc)}$ = ___________

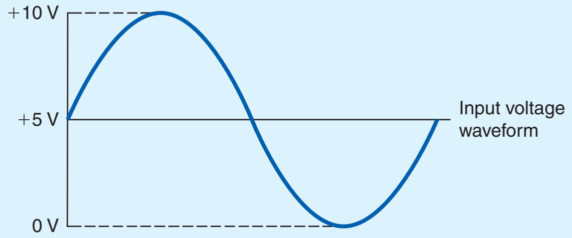
Construct the circuit in Fig. 26–43*a*. With a DMM connected to the output of the function generator, adjust the dc offset control to obtain a dc value of +5 V dc. Also, while viewing the oscilloscope, adjust the amplitude and frequency controls of the function generator to obtain an output voltage of 10 V_{P-P} with a frequency of 1 kHz. Have your instructor check your settings. Next, measure and record the following values in Fig. 26–43*a*:
$V_{in(dc)}$ = ___________, $V_{in(rms)}$ = ___________,
$V_{C(dc)}$ = ___________, $V_{R(dc)}$ = ___________
How do these values compare to those predicted? ___________
____

In Fig. 26–43*a*, calculate X_C and Z_T at 1 kHz. X_C = ___________,
Z_T = ___________
Next, calculate and record the following rms values:
I = ___________, V_C = ___________, V_R = ___________
Using your DMM, measure and record the following rms values:
V_C = ___________, V_R = ___________

Figure 26–43



(*a*)



(*b*)

How do your calculated and measured rms values compare?

____

Measure and record the peak-to-peak output voltage across *R* using the oscilloscope. V_{out} = __________ $_{P\text{-}P}$. How does this value compare to the peak-to-peak value of input voltage? ____

____

RC Low-Pass Filter

Examine the *RC* low-pass filter in Fig. 26–44. Calculate and record the cutoff frequency, f_C. f_C = __________

Construct the *RC* low-pass filter in Fig. 26–44. The input voltage should be set to exactly 10 $V_{P\text{-}P}$ with no dc offset.

Measure and record the output voltage from the *RC* low-pass filter for each of the frequencies listed below. (Use the oscilloscope to measure the output voltage.) Next, calculate the decibel attenuation offered by the filter at each frequency.

f = 100 Hz	$V_{out(p\text{-}p)}$ = __________	N_{dB} = __________
f = 250 Hz	$V_{out(p\text{-}p)}$ = __________	N_{dB} = __________
f = 500 Hz	$V_{out(p\text{-}p)}$ = __________	N_{dB} = __________
f_C (Calculated)	$V_{out(p\text{-}p)}$ = __________	N_{dB} = __________
f = 10 kHz	$V_{out(p\text{-}p)}$ = __________	N_{dB} = __________
f = 20 kHz	$V_{out(p\text{-}p)}$ = __________	N_{dB} = __________
f = 100 kHz	$V_{out(p\text{-}p)}$ = __________	N_{dB} = __________

Do the measured values of output voltage confirm that the circuit is a low-pass filter? ____________________

Rate of Rolloff

Based on your measured values in Fig. 26–44, what is the rate of rolloff when *f* is increased by one octave from 10 kHz to 20 kHz?

____________________.

Based on your measured values in Fig. 26–44, what is the rate of rolloff when *f* is raised by one decade from 10 kHz to 100 kHz?

____________________.

Figure 26–44