



B38EB Circuits and Analysis
AC power calculations and maximum power transfer Laboratory

Name	Signed	Date
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Circuit 1: Maximum power transfer

- (a) Consider the circuit of Figure 1 and the component values of Table 5. Write an expression for the average power P delivered to the load in terms of V_s , R_s and the load resistance R_i . Complete the entries of Table 5 corresponding to the theoretical values. Include the calculations on a separate sheet.

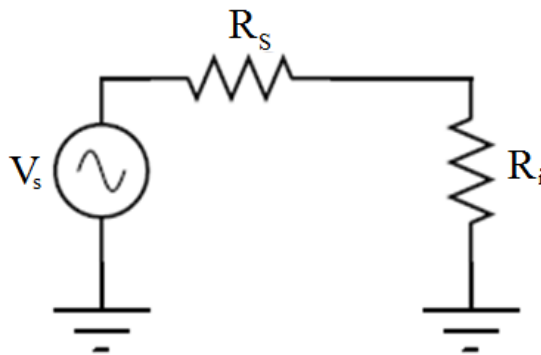


Figure 1. Maximum power transfer test circuit

Table 1. Maximum power transfer calculations

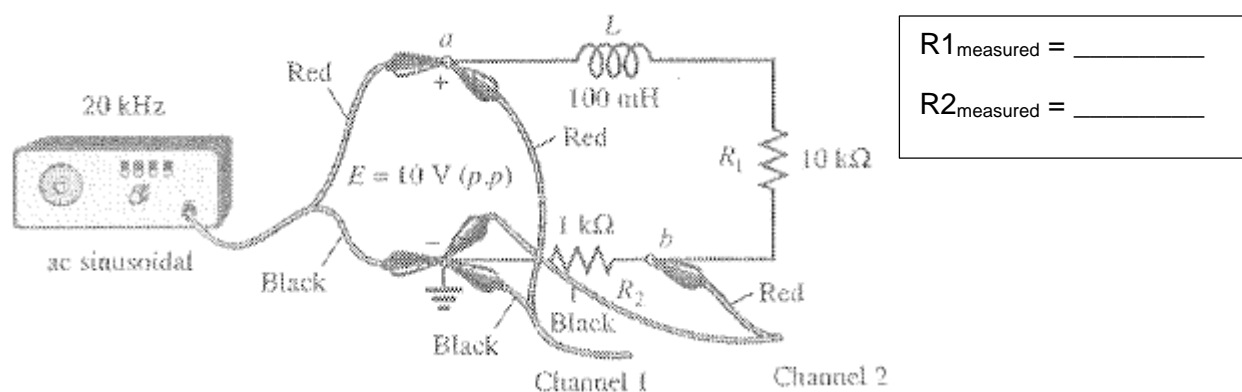
Param.	Unit	Theoretical	Experimental	Param.	Unit	Theoretical	Experimental
R_s	Ohm	50	-	V_s	V	2	-
R_1		24		P1	mW		
R_2		51		P2			
R_3		100		P3			

- (b) Assemble the circuit of Figure 1 using the component values of Table 1. Use a signal frequency of 1 kHz. For each value of R_i measure the RMS voltage across the load and calculate the experimental values of Table 1.
- (c) From the results of Table 1, determine which of the three resistor values gives the maximum power transfer. Compare this resistor value with the source resistance R_s .

Circuit 2: Power factor and power factor correction

Part 1 Uncorrected F_p

(a) Construct the circuit shown in Figure 2.



(b) Connect the oscilloscope Channel 1 to point "a" on the circuit and Channel 2 to point "b". Make sure you ground the oscilloscope as indicated.

(c) Set the function generator for an ac sinusoidal waveform with a frequency of 20 kHz and an amplitude of 10 volts peak to peak. Determine the rms value of the applied signal.

$$V_{\text{rms}} = \underline{\hspace{2cm}}$$

(d) Using the oscilloscope measure the peak to peak voltage on Channel 2. This is the voltage across the 1.0 k Ω resistor. Convert this to V_{rms} and calculate the current in the circuit.

$$I_{\text{rms}} = \underline{\hspace{2cm}}$$

(e) Notice the phase shift, θ of the two waveforms and that Channel 2 is to the right of the Channel 1. This means that Channel 2 is "lagging" Channel 1. Measure this phase shift in degrees.

$$\theta = \underline{\hspace{2cm}}$$

(f) Fill in the "Uncorrected Data" Table 2 with the measured values and then compute P , S , Q and F_p .

Table 2. Uncorrected Data

Vrms	Irms	Phase shift θ , Degrees	F_p	P	Q	S

Calculations:

(g) From the values in Table 2 "Uncorrected Data", sketch the power triangle showing all the values including θ .

Part 2 Corrected F_p

(a) Place a 100 pF capacitor between points “a” and “b” of the circuit. Measure the phase shift θ and indicate if it is lagging or leading.

(b) Measure the voltage on Channel 2 and then calculate the current using rms values.

(c) Repeat steps (a) and (b) with the following capacitors: 220 pF, 330 pF, 470 pF and 1000 pF (only one capacitor at a time).

(a) through (c) Fill in Table 3 with the data from steps (a) through (d).

Table 3.

Capacitor pF	Phase shift θ , degrees	Leading/ Lagging	Current mA
100			
220			
330			
470			
1000			
C_T			

I = _____

(d) Make a plot of current vs. the phase shift

(e) Calculate the capacitance required for the unity power factor. This occurs when the inductive VARs equal the capacitance VARs.

$C =$ _____

(f) Place this capacitor (as close as possible using the available capacitors) between points “a” and “b”. be sure to remove all other capacitors.

(g) The phase shift should be close to 0 degrees. If it isn't try combining some of the other capacitors achieve unity F_p ($\theta = 0^\circ$). Remember that capacitors add when connected in parallel. Record the resulting capacitance as C_T below.

$C_T =$ _____

(h) Measure the voltage on channel 2 and then calculate the current using rms values.

$V_{rms} =$ _____

$I_{rms} =$ _____

(i) Fill the “corrected data” in Table 4 using the capacitance C_T to produce a phase shift very close to 0 degrees. In Table 4, indicate whether F_p is lagging or leading and whether Q is inductive or capacitive.

Table 4. Corrected Data

V_{rms}	I_{rms}	Phase shift θ , Degrees	F_p	P	Q	S

(j) From the values in Table 4 “corrected Data”, construct a power triangle showing all of values.

P = _____

Q = _____

S = _____