

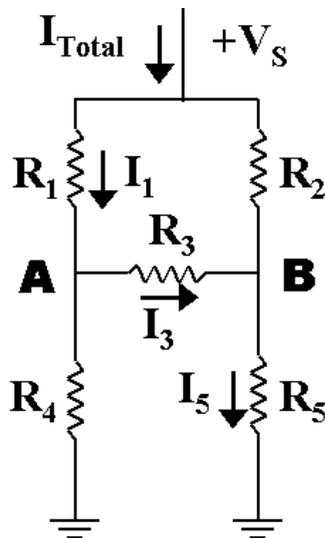
Part 1: Build the circuit (up to 1 point out of 8)

- From the components bins get five (5) resistors according to the Table below.
- Measure the resistor values and write them in column 3 of the Table below with all significant digits displayed by the instrument. **Do not write in column 4.**

1	2	3	4
Resistor	Nominal value Ω	Actual value (student's measurements)	Control measurement by the Lab instructor (optional)
R_1	910		
R_2	200		
R_3	100		
R_4	240		
R_5	560		

The measured resistances should match the nominal values within the tolerance of 5%. If your measured values are outside the tolerance range, immediately inform your Lab instructor: you will get other resistors, and the 50-minute time count will be reset.

- On a bare circuit board, build the following circuit:



- Connect your circuit to the power supply and apply the DC voltage $+V_S = 11$ Volts
The display of your power supply should read within 1% of the assigned voltage.

The current displayed by your power supply should not exceed 100 mA. If the current you see is larger than 100 mA, press the **Output On/Off** button on the power supply, notify your Lab instructor, find the mistake in your circuit and try again.

Measurements with HP 34401A multimeter

Part 2: Measure DC Voltages (up to 1 point out of 8)

• Use HP 34401A multimeter to measure three (3) DC voltages in your circuit, according to the Table below. Write the results in column 2 of the Table with all significant digits displayed by the instrument. Remember to include the sign: some values may be negative. **You do not have to calculate anything. Do not attempt to write the values expected from theory:** your Lab instructor will write them while grading your exam.

Do not write in columns 3, 4, 5.

1	2	3	4	5
Voltage	Result of the student's measurement	Control measurement by the Lab instructor (optional)	The value expected from theory	Pass / Fail
V_A				
$V_B - V_A$				
$V_B - V_S$				

Part 3: Measure DC Currents (up to 2 points out of 8)

• Use HP 34401A multimeter to measure three (3) DC currents in your circuit according to the Table below. Write the results in column 2 of the Table with all significant digits displayed by the instrument. Remember to include the sign: some values may be negative. **You do not have to calculate anything. Do not attempt to write the values expected from theory:** your Lab instructor will write them while grading your exam.

Do not write in columns 3, 4, 5.

1	2	3	4	5
Current	Result of the student's measurement	Control measurement by the Lab instructor (optional)	The value expected from theory	Pass / Fail
I_1				
I_3				
I_5				

• When you complete the voltage and current measurements, keep your circuit on the circuit board, do NOT disconnect it from the power supply, press the **Output On/Off** button on the power supply, but do NOT turn off the instruments.

Measurements with HP 54645A oscilloscope

- When you start working with HP33120A function generator, set it in the **HIGH Z** mode.
- When you start working with HP 54645A oscilloscope, run the **Setup** **Default setup** sequence. Make sure that the peak-to-peak amplitude readings of the two instruments agree within a few percent.

The following fragments of your Lab Book might help you in this assignment.

- Your function generator has a built-in memory that includes, among other things, a list of 5 special, or “Arbitrary” functions named **SINC**, **NEG_RAMP**, **EXP_RISE**, **EXP_FALL**, and **CARDIAC**.
- On your function generator press **Shift** then **Arb List** button and browse through the list of special function names by pressing the **▶** arrow button. **Each function name is displayed only for a few seconds. To choose a function, press **Enter** while its name is displayed.** Notice that the **Arb** annunciator will be displayed in small characters, but it does *not* explain *which* function you chose. *Be attentive!*
- Several “Arbitrary” waveforms may be unstable on the screen of your oscilloscope. To measure them, choose the **External trigger**. Use the **SYNC** (Synchronization) output signals from your function generator as the **External trigger** source.
- When used with the **External trigger**, some of the “Arbitrary” waveforms may be displayed off center of your oscilloscope screen. When you choose a smaller setting of **Time/Div** to “zoom in,” the interesting part of the waveform might disappear from the screen.
- To keep the interesting part of the function within the screen, turn the **HORIZONTAL Delay** knob.
- Move the interesting part of the waveform to the center of the screen and *then* choose a smaller setting of **Time/Div** to “zoom in.”
- Some of the “Arbitrary” waveforms may look too small on the screen. They are also offset to positive voltages. Before you adjust **Volts/Div** to make them look larger, move the waveforms toward the center of the screen by turning the **VERTICAL Position** knob.
- You can go back from the chosen “Arbitrary” waveform to any standard waveform (sine, square, triangular, saw-tooth) by pressing the key of the standard waveform on your function generator. To return to the chosen “Arbitrary” waveform, press the **Arb** key.

Part 4: Measure Rise and/or Fall Time (up to 2 points out of 8)

On HP 33120A function generator set the amplitude of 1 V ppk while you still have the default sine wave. *Then* choose the function and its frequency according to the table below. The peak-to-peak value displayed by your function generator may change as you go from sine wave to the special function. Take it easy and do not waste time resetting the amplitude.

Measure the required parameters and write them in the table below with all digits displayed by HP 54645A oscilloscope. If the signals or readings get unstable, run the **Setup Default setup** sequence and start again.

Function name and frequency: EXP_RISE at 4.9 kHz	Result of student's Measurements	Expected value	Pass / Fail
Rise Time			
Fall Time			

Function name and frequency: CARDIAC at 67 Hz	Result of student's Measurements	Expected value	Pass / Fail
Fall Time (of the main peak)			

Part 5: Measure amplitudes in dBV in the FFT spectrum (up to 2 points out of 8)

- On the function generator, set the frequency $f_0 = 10$ kHz ;
set the Triangular waveform
set the peak-to-peak amplitude = 4 V ppk

Measure the amplitudes in dBV of three (3) components of the FFT spectrum, according to the Table below. Write the results of your measurements in column 2 of the Table with all significant digits displayed by the instrument. Some values may be negative: do not forget to include the sign. Remember to measure the frequency of each component with the frequency cursor: **do not guess which peak corresponds to the harmonic you need.**

Do not write in columns 3, 4, 5.

1	2	3	4	5
Frequency Components (Harmonics)	Amplitude of the frequency component in dBV			Pass / Fail
	Result of the student's measurement	Control measurement by the Lab instructor (optional)	The value expected from theory	
3rd				
5th				
7th				

- **Do NOT turn off the instruments. Do NOT disconnect them from each other.**