

FUNCTION GENERATOR

PRE-LAB

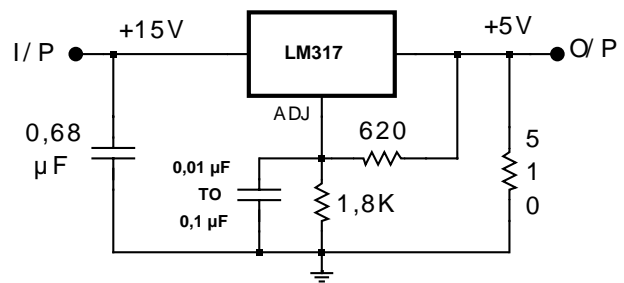
(Fill out table on page 3 with pre-lab results)

Analyze the function generator circuit shown on page 4 in order to determine:

- A) the +ve and -ve peak voltages at test points TP1 and TP2 - assume $V_{sat} = +0,6V$ for LM319
- B) the +ve and -ve peak voltages at test point TP3 and the THD of the sinewave at 1 kHz - assume that the 5k pot is set exactly midway. Use microcap to determine the answer.
- C) the minimum and maximum frequencies in all four ranges assuming that duty cycle switch is at the position shown on the diagram.
- D) the duty cycle adjustment range of the squarewave at the VCO O/P assuming $R_{ds(on)}$ of the FET is negligible.
- E) the DC offset adjustment range at the O/P.
- F) the adjustment range of V_o pp for all three waveforms when the attenuation is set to 0 dB.
- G) the three attenuation settings.
- H) Determine the gain response of op amp stages A-3 through A-8 and explain whether the maximum frequency signals will be attenuated.

Circuit Diagram of +5V Regulator

Observe switching spikes on +5V O/P once it is connected to your working VCO. This is why you need to by-pass IC supply pins to ground because regulator is unable to respond fast enough to a sudden current surge in its load.



PROCEDURE

PART 1 VOLTAGE-CONTROLLED OSCILLATOR

- Assemble the circuit and be careful to match the following resistors with a digital ohmmeter: the two 13k resistors at the +ve I/P of A2 and the two 1,5k resistors of the sineshaper. The 3,4K of the VCO should be trimmed to exactly half of the measured value of the 6,8k resistor.
- With maximum V_C and $D/C=50\%$, use the **DMM** to measure the maximum frequency and the rms voltage (AC) of the waveforms at BUFFERED test points TP1 and TP2 for all four frequency ranges. Also measure the peak-to-peak voltages using the oscilloscope. Enter your results in the table shown below, then using the measured values verify that the ratio V_{peak} / V_{rms} is given by 1 and $\sqrt{3}$ for a square wave and a triangular wave respectively.

RANGE	F_{max} (Hz)	Buffered TP1			Buffered TP2			Buffered TP3		
		V_{rms}	V_{pp}	V_p/V_{rms}	V_{rms}	V_{pp}	V_p/V_{rms}	V_{rms}	V_{pp}	V_p/V_{rms}
x1										
x10										
x100										
x1000										

3. Using the maximum frequency on the X10 frequency range, adjust the 5k pot for minimum THD of the sinewave observed at buffered TP3 - use distortion meter and record minimum THD.

Also measure the THD on the X1 and X100 frequency ranges with the distortion meter - do not alter the 5k pot setting. Observe the sinewave on the oscilloscope and measure its peak to peak amplitude and measure its rms value with the DMM and enter the values in the table shown in step 2 - verify that V_{peak} / V_{rms} is given by $\sqrt{2}$ for a sinewave .

Is the sinewave observed on the oscilloscope visually acceptable? Draw waveform and explain. According to the THD measurements, is the sinewave acceptable? Explain.

4. Measure the VCO characteristic (Frequency versus V_C) for the **X10** frequency range: increment V_C from 0 to 10V in steps of 1V and measure the corresponding frequency of the VCO with the DMM. Plot the data on a millimetric graph. If the graph is linear, draw the best line and calculate its slope which determines the VCO sensitivity in Hz/V.

5. Repeat step 4 for the **X100** frequency range.

6. Observe the buffered TP2 squarewave O/P on the oscilloscope and measure the adjustment range of the duty cycle on the X10 range. Compare to pre-lab. D/C range= _____

PART 2 DC OFFSET AND AMPLITUDE CONTROL

1. Select GROUND with waveform selector and set the ATTENUATION to 0 dB. Vary the DC offset control pot from one end to the other and measure the corresponding final DC O/P voltage range. Compare to pre-lab values.

2. Re-adjust the DC offset control for 0V DC at the O/P. Measure the adjustment range of the final O/P amplitude for all three waveforms at 1 kHz using the oscilloscope and the DMM. Compare to pre-lab values.

3. Measure the three attenuation settings with the **DVM on relative dB** using approximately 5V (rms) O/P sinewave at 1 kHz when the attenuation is set to 0 dB. Compare to pre-lab values.

4. Measure the 0%-100% rise and fall times of the squarewave at the final output with a maximum amplitude squarewave at the maximum frequency of the VCO on the X1000 range t_R =_____ t_F =_____

Also measure the +ve and -ve slew rates. +ve SR = _____

-ve SR = _____

Compare the slew rates to the typical value given in the data sheets. SR(typ)=_____

DISCUSSION

1. Compare all measured values to pre-lab values and explain any major discrepancies.
2. How could we modify the circuit such that the frequency would be an exact multiple of 10, 100 and 1000 when switching ranges while V_C remains the same?

Function Generator Pre-Lab -- Attach all calculations to table

NAME: _____

PARTNER: _____

A	+ve peak voltage TP1	-ve peak voltage TP1	+ve peak voltage TP2	-ve peak voltage TP2
B	+ve peak voltage TP3	-ve peak voltage TP3	THD of sinewave	
C	$F_{min} \rightarrow F_{max}$ (X1)	$F_{min} \rightarrow F_{max}$ (X10)	$F_{min} \rightarrow F_{max}$ (X100)	$F_{min} \rightarrow F_{max}$ (X1000)
D	Minimum duty cycle		Maximum duty cycle	
	%		%	
E	Vo (DC) minimum		Vo (DC) maximum	
F	Vo (AC) minimum		Vo (AC) maximum	
	Vpp		Square Vpp	Triangular Vpp
			Sine Vpp	
G	Attenuation settings	selector UP	selector MIDDLE	selector DOWN
			(dB)	(dB)
H	A-3 F _{LO} F _{HI}	A-4 F _{LO} F _{HI}	A-5 F _{LO} F _{HI}	A-6 F _{HI1} F _{HI2}
				A-8 F _{LO} F _{HI}

H) Will HF signal be attenuated? Explain.

