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RS

DATA SHEET

WAVEFORM GENERATORS 305-844 & 306-314

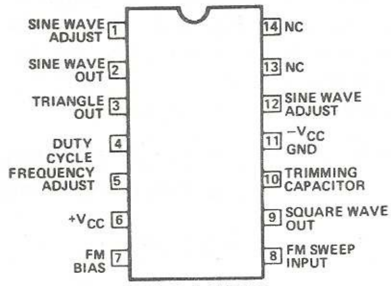
These Waveform Generators are monolithic integrated circuits capable of producing SINE, SQUARE, TRIANGULAR SAWTOOTH, RAMP and PULSE waveforms of high accuracy. The frequency can be selected externally over a range from less than 0.001 Hz to over 1 MHz, and is highly stable over a wide range of temperature and supply voltage. Frequency modulation and sweeping can be accomplished with an external voltage. Two versions are available having different frequency drifts with temperature but otherwise identical specifications.

FEATURES

Simultaneous outputs	SINE, SQUARE, TRIANGLE
Wide frequency range	0.001 Hz to 1 MHz
Low distortion	1%
Variable duty cycle	2% to 98%

MAXIMUM RATINGS

Supply Voltage	± 18V or 36V Total
Power Dissipation	750mW
Input Voltage (any pin)	Not To Exceed Supply Voltages
Input Current (Pins 4 and 5)	25mA
Output Sink Current (Pins 3 and 9)	25mA
Storage Temperature Range	-65°C to +125°C
Operating Temperature Range	0°C to +70°C



TOP VIEW

ELECTRICAL CHARACTERISTICS (V_S = ± 5V to ± 15V, T_A = 25°C, R_L = 1MΩ, Unless Otherwise Specified)

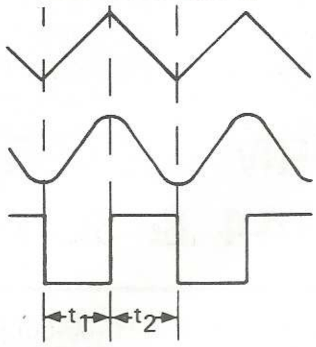
GENERAL CHARACTERISTICS	MIN	TYP	MAX	UNITS
Supply Voltage:				
Single Supply	+10		+30	V
Dual Supplies	± 5		± 15	V
Supply Current (V_S=± 10V) (excludes current into pins 4 & 5)		12	20	mA
FREQUENCY CHARACTERISTICS (all waveforms)				
Range of Adjustment	0.001		1,000,000	Hz
Sweep Frequency of FM		100		kHz
Sweep FM Range (V_S = 20V)		1000:1		
Frequency Drift With Temperature (Over Operating Temperature Range)				
305 - 844 type †		50		ppm/°C
306 - 314 type †		50	100	ppm/°C
Frequency Drift With Supply Voltage (Over Supply Voltage Range)		0.05		%/V_S
Recommended Programme Resistors (R_A and R_B)	500		1M	Ω
OUTPUT CHARACTERISTICS f < 50kHz				
Square - Wave				
Amplitude (R_L = 100kΩ)	0.9			xV_S
Saturation Voltage (I_{SINK} = 2mA)		0.2	0.5	V
Rise Time (R_L = 4.7kΩ)		100		ns
Fall Time (R_L = 4.7kΩ)		40		ns
Duty Cycle Adjust	2		98	%
Triangle/Sawtooth/Ramp				
Amplitude (R_L = 100kΩ)	0.30	0.33		xV_S
Linearity		0.1		%
Output Impedance (I_{OUT} = 5mA)		200		Ω
Sine - Wave				
Amplitude (R_L = 100kΩ)	0.2	0.22		xV_S
THD (R_L = 1MΩ) *		0.8	3	%
THD Adjusted (R_L = 1MΩ)		0.5		%

*81kΩ connected between pins 11 and 12

† Vss = ± 10V as Fig. 4a with R_A = R_B = 10k and C = 3.3nF

PHASE RELATIONSHIPS OF WAVEFORMS

DUTY CYCLE 50%



DUTY CYCLE 20%

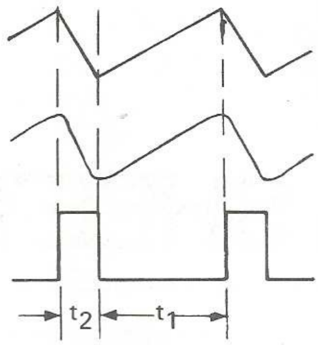
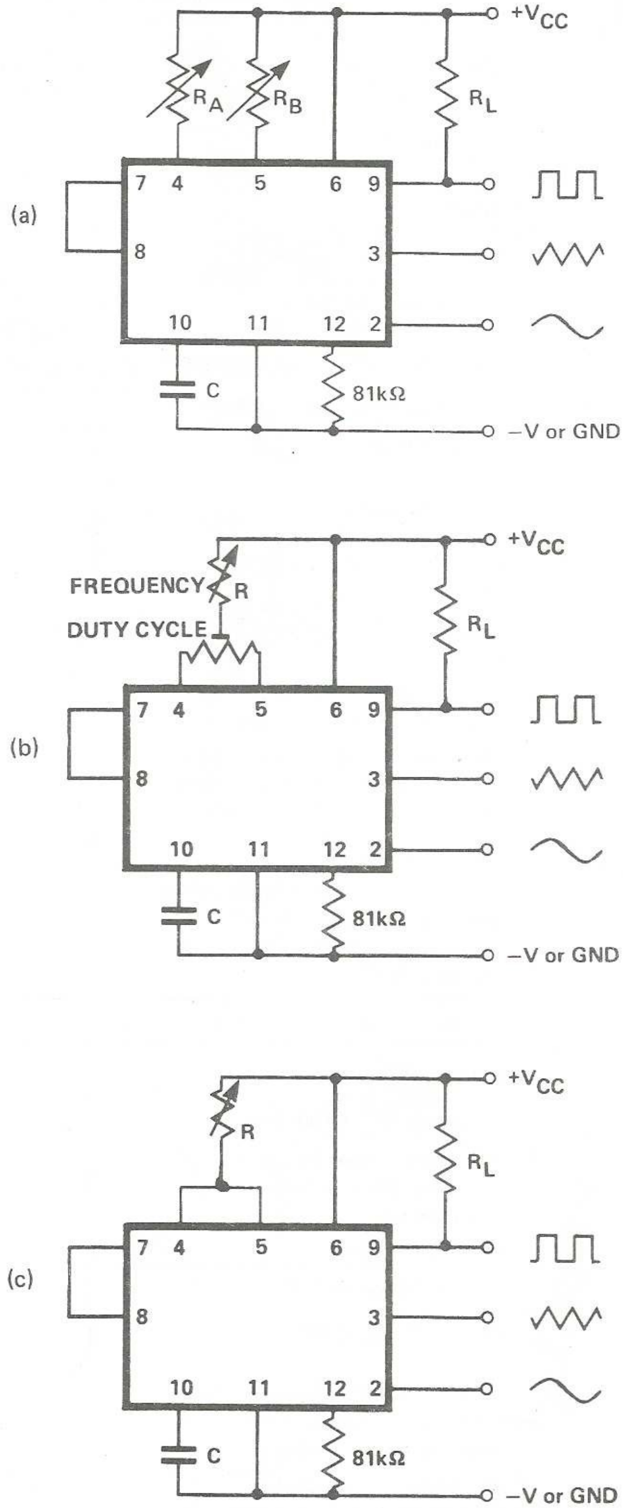


FIG. 4: External timing resistor connections



WAVEFORM TIMING

The symmetry of all waveforms can be adjusted with the external timing resistors. Two possible ways to accomplish this are shown in Figure 4. Best results are obtainable by keeping the timing resistors R_A and R_B separate (a). R_A controls the rising portion of the triangle and sine-wave and the 0 state of the square-wave.

The magnitude of the triangle-waveform is set at $1/3\ V_{CC}$: therefore the rising portion of the triangle is,

$$t_1 = 5/3\ CR_A$$

The falling portion of the triangle and sine-wave and the 1 state of the square-wave is:

$$t_2 = 5/3 \times \frac{R_A R_B C}{2R_A - R_B}$$

Thus a 50% duty cycle is achieved when $R_A = R_B$.

If the duty cycle is to be varied over a small range about 50% only, the connection shown in Figure 4b is slightly more convenient. If no adjustment of the duty cycle is desired, terminals 4 and 5 can be shorter together; as shown in Figure 4c. This connection, however, carries an inherently larger variation of the duty-cycle.

With two separate timing resistors, (Figure 4a) the frequency is given by

$$f = \frac{0.3}{RC} \qquad (R = R_A = R_B)$$

If a single timing resistor is used (Figure 4c), the frequency is

$$f = \frac{0.15}{RC}$$

Neither time nor frequency are dependent on supply voltage,even though none of the voltages are regulated inside the integrated circuit. This is due to the fact that both current and thresholds are direct, linear function of the supply voltage and thus their effects cancel.

SELECTING R_A, R_B and C

For any given output frequency, there is a wide range of RC combinations that will work. However certain constraints are placed upon the magnitude of the charging current for optimum performance. At the low end, currents of less than 1μA are undesirable because circuit leakages will contribute significant errors at high temperatures. At higher current ($I > 5mA$), transistor betas and saturation voltages will contribute increasingly larger errors. Optimum performance will be obtained for charging currents of 10μA to 1 mA. If pins 7 and 8 are shorted together, themagnitude of the charging current due to R_A can be calculated from:

$$I = \frac{V_{CC}}{5R_A} \quad (R = R_A \text{ or } R_B)$$

For optimum stability capacitor C should be a low temp. coefficient type, e.g. silvered mica, polystyrene, etc.

Note: Pins 7 and 8 are susceptible to pick-up, therefore a 0.1μF capacitor connected from + V_{CC} to pin 8 is often advisable.

WAVEFORM LEVEL AND POWER SUPPLIES

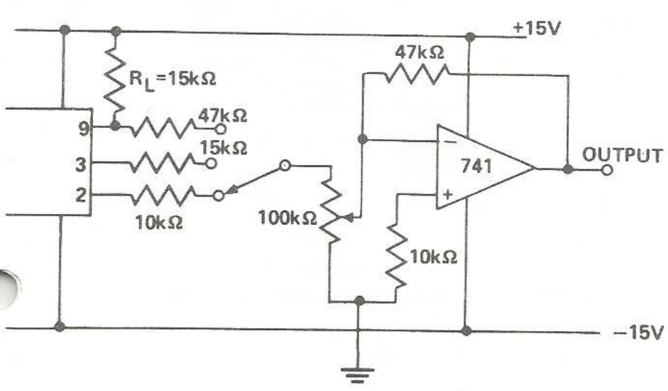
The waveform generator can be operated either from a single power-supply (10 to 30 Volts) or a dual power-supply ($\pm$5 to $\pm$15 Volts). With a single power-supply the average levels of the triangle and sine-wave are at exactly one-half of the supply voltage, while the square-wave alternates between +V and ground. A split power supply has the advantage that all waveforms move symmetrically about ground.

The square-wave output is not committed. A load resistor can be connected to a different power-supply, as long as the applied voltage remains whithin the breakdown capability of the waveform generator (30V). In this way the square-wave output be made TTL compatible (load resistor connected to +5 Volts) while the waveform generator itself is powered from a higher voltage.

OUTPUT BUFFERING

To prevent overload and to provide maximum amplitude the output should not be connected to a load of less than 10kΩ. In some applications an output buffer may therefore be required. Fig. 6 shows a comprehensive buffer circuit allowing amplitude adjustment and waveform selection. Using the component values indicated the selected waveforms will have nominally the same output amplitude.

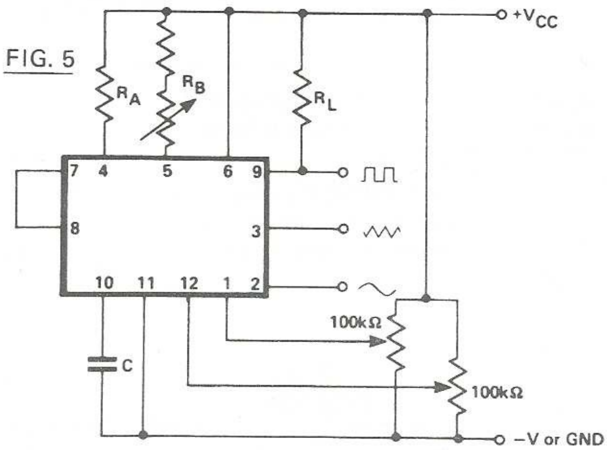
FIG. 6



SINE WAVE DISTORTION

To minimize sine-wave distortion the 81k resistor between pins 11 and 12 is best made a variable one. With this arrangement distortion of less than 1% is achievable. To reduce this even further, two potentiometers can be connected as shown in Figure 5. This configuration allows a reduction of sine-wave distortion close to 0.5% for frequencies less than 50KHz.

FIG. 5



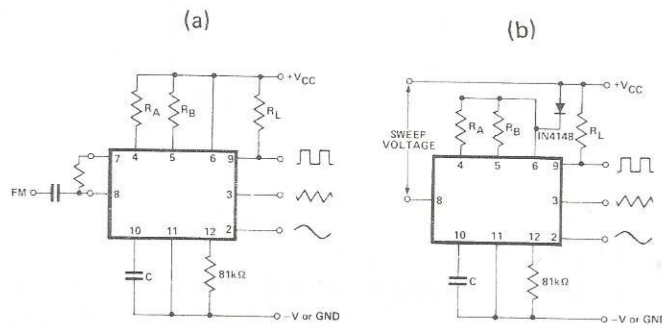
FREQUENCY MODULATION AND SWEEPING

The frequency of the waveform generator is a direct function of the DC voltage at terminal 8 (measured from +V_{CC}). By altering this voltage, frequency modulation is performed.

For small deviations (e.g. $\pm$ 10%) the modulating signal can be applied directly to pin 8, merely providing dc decoupling with a capacitor, as shown in Figure 7a. An external resistor between pins 7 and 8 is not necessary, but it can be used to increase input impedance. Without it (i.e. terminals 7 and 8 connected together), the input impedance is 8kΩ; with it, this impedance increases to (R+8kΩ).

For larger FM deviations or for frequency sweeping, the modulating signal is applied between the positive supply voltage and pin 8 (Figure 7b). In this way the entire bias for the current sources is created by the modulating signal and a very large (e.g. 1000:1) sweep range is created (f=0 at V_{sweep}=0). Care must be taken, however, to regulate the supply voltage; in this configuration the charge current is no longer a function of the supply voltage (yet the trigger thresholds still are) and thus the frequency becomes dependent on the supply voltage. The potential on Pin 8 may be swept from V_{CC} to 2/3 V_{CC}.

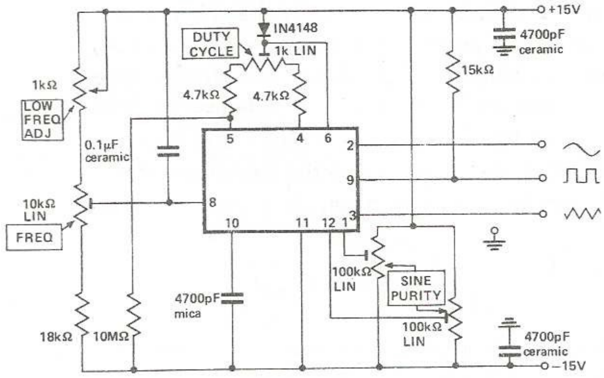
FIG. 7



TYPICAL APPLICATIONS CIRCUITS

AUDIO OSCILLATOR

A versatile audio oscillator giving simultaneous Sine, Square and Triangular outputs from 20Hz to 20KHz without the need to switch range. This wide range of adjustment is achieved by connecting the F.M. Sweep input to the 'Frequency' setting potentiometer which adjusts a d.c. control voltage. This oscillator circuit may be combined with a suitable power supply and the Output Buffer Circuit to produce a general purpose instrument for use where either fixed or variable frequency Waveforms are required.

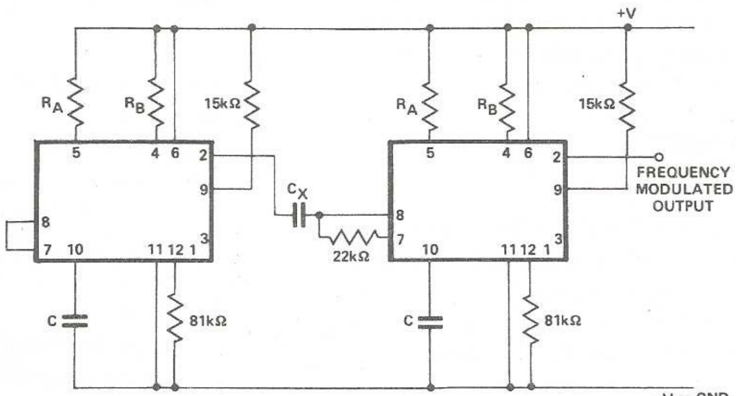


If this circuit is used without an output buffer then the load should not be less than 10KΩ on any output.

Adjust LOW FREQUENCY preset so that with FREQUENCY potentiometer set for minimum frequency the low frequency output is 20Hz.

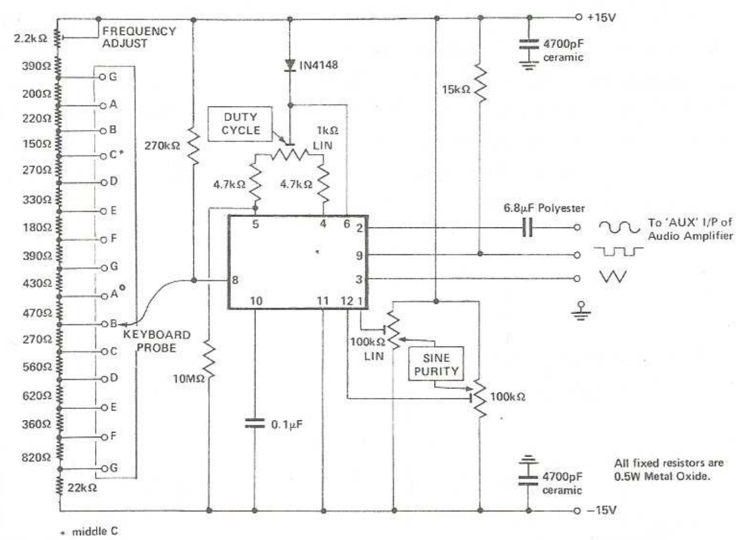
FREQUENCY MODULATION

The circuit below illustrates the basic method whereby two Waveform Generator I.C's can be used to achieve a frequency modulated Waveform. In this mode the first I.C. produces a sine-wave which is coupled via C_X to the second I.C. where it modulates its set frequency by up to 10 per cent as desired. The value of C_X should be chosen to suit the modulating frequency. Refer to previous information to determine values of R_A, R_B, C to set the frequency of each oscillator.



SIMPLE ELECTRONIC ORGAN

A development of the Audio Oscillator circuit above; this Electronic Organ when used in conjuction with an audio amplifier and loudspeaker makes an effective instrument, even in this simple form.



SETTING UP PROCEDURE

Connect the 'Keyboard Probe' to Å above middle C and adjust 2.2KΩ frequency adjust to give output frequency of 440Hz. (If frequency counter not available adjust A note against a Piano "by ear".) With A note selected adjust the 'Duty Cycle' on the square wave for equal mark/space ratio on the square wave output displayed on a scope and then adjust the 'sine purity' controls for minimum distortion of the sine wave displayed on a scope.

[Note:- Values of resistance used are nearest prefered values]

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