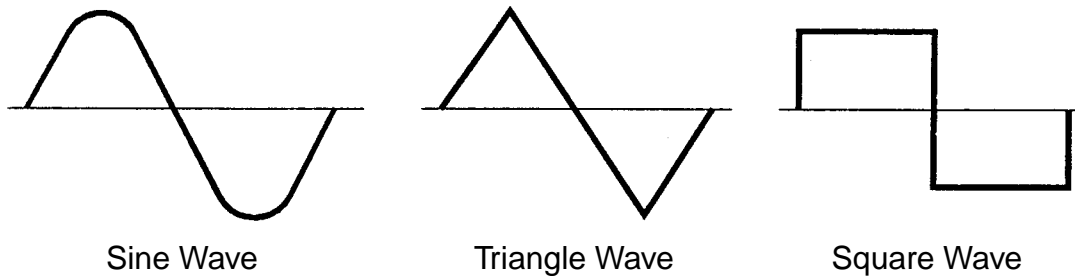


FUNCTIONAL DESCRIPTION

The FG-500 is a function generator integrated circuit capable of producing high quality sine, triangle, and square waves of high stability and accuracy. A picture of each waveform is shown below:



Sine Wave

Triangle Wave

Square Wave

THEORY OF OPERATION

The heart of the FG-500 Function Generator is the XR-2206 monolithic function generator integrated circuit. The XR-2206 is comprised of four main functional blocks as shown in the functional block diagram (Figure 1). They are:

- A Voltage Controlled Oscillator (VCO)
- An Analog Multiplier and Sine-shaper
- Unity Gain Buffer Amplifier
- A set of current switches

The VCO actually produces an output frequency proportional to an input current, which is produced by a resistor from the timing terminals to ground. The current switches route one of the currents to the VCO to produce an output frequency. Which timing pin current is used, is controlled by the FSK input (pin 9). In the FG-500, the FSK input is left open, thus only the resistor on pin 7 is used. The frequency is determined by this formula:

$$f_o = 1/RC \text{ Hz}$$

- where
- f_o is the frequency in Hertz
 - R is the resistance at pin 7 in Ohms
 - C is the capacitance across pin 5 and 6 in Farads

Note that frequency is inversely proportional to the value of RC. That is, the higher the value of RC, the smaller the frequency.

The resistance between pins 13 and 14 determine the shape of the output wave on pin 2. No resistor produces a triangle wave. A 200Ω resistor produces a sine wave.

FUNCTIONAL BLOCK DIAGRAM

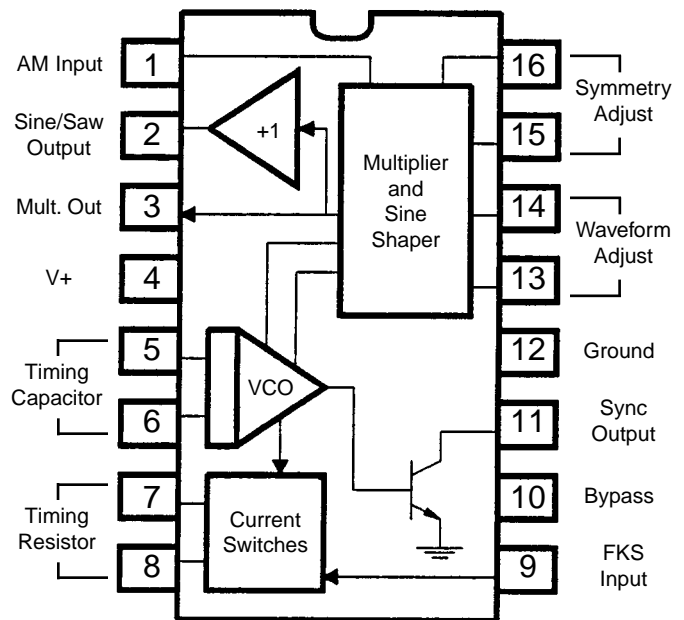


Figure 1

CONTROLS

RANGE SWITCHES

Six ranges of frequency are provided by the range switch as shown in Table 1.

POSITION	TYPICAL FREQUENCY RANGE
1	1Hz - 15Hz
2	10Hz - 150Hz
3	100Hz - 1.5kHz
4	1kHz - 15kHz
5	10kHz - 150kHz
6	100kHz - 1MHz

Table 1

SINE/TRIANGLE SWITCH

This SINE/TRIANGLE Switch selects the waveform, sine wave or triangle wave, sent to the SINE/TRIANGLE output terminal.

FREQUENCY MULTIPLIER

The multiplier is a variable control allowing frequency settings between fixed ranges. The ranges are as shown in Table 1.

AMPLITUDE CONTROL

The Amplitude Control provides amplitude adjustment from near 0 to 3V or greater for both sine and triangle waveforms.

ON/OFF SWITCH

The ON/OFF Switch turns the power to the FG-500 on or off.

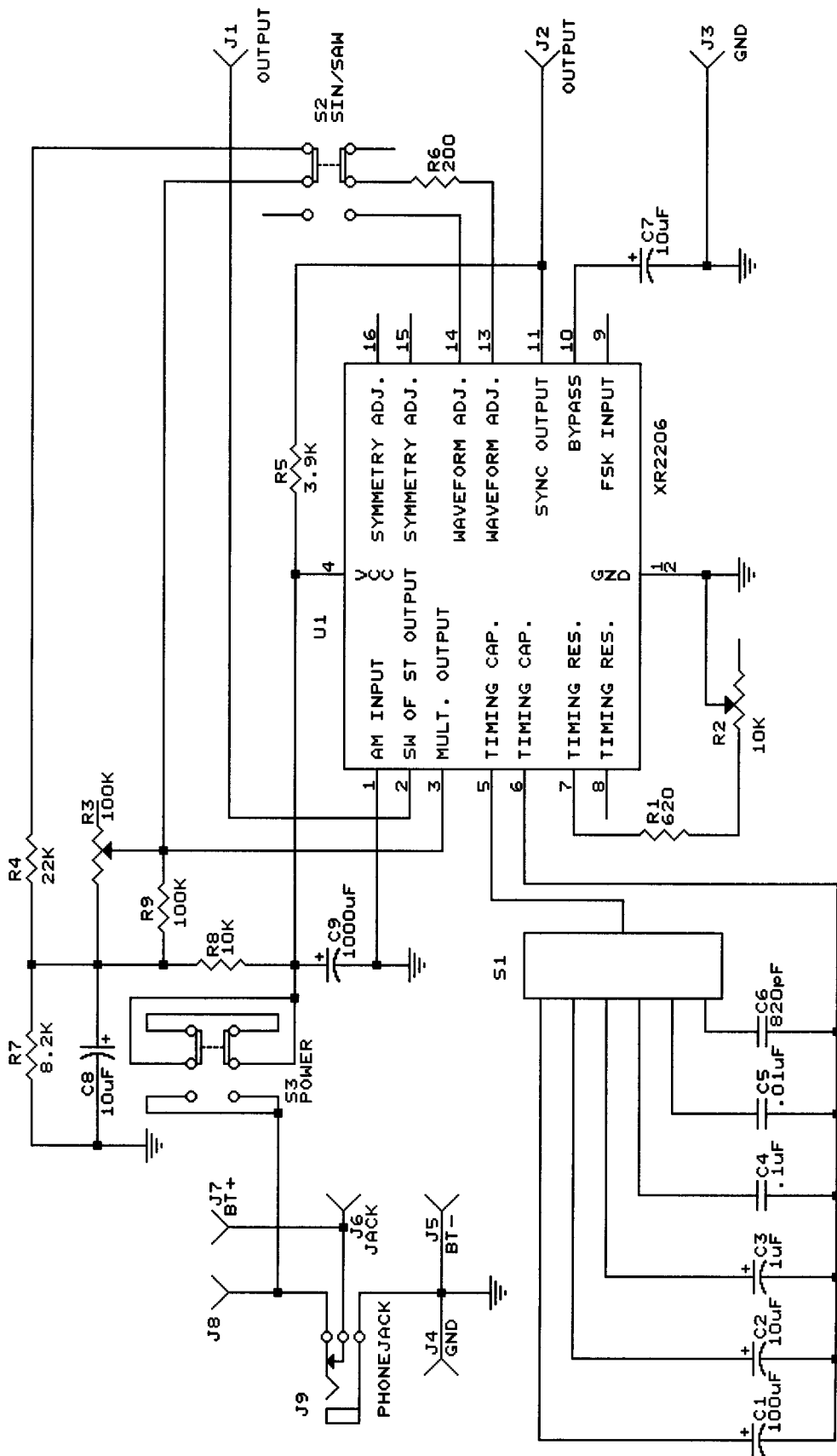
POWER JACK

This jack allows the FG-500 to be powered from an external power source of 9V to 18VDC. Putting a plug into the jack disconnects the internal 9V battery.

OUTPUT TERMINAL

The output marked SINE/TRIANGLE provides the sine and triangle waveforms. The output marked SQUARE WAVE provides the square wave. The output marked GND provides the ground for all output waveforms.

SCHEMATIC DIAGRAM



PARTS LIST

Contact Elenco Electronics (address/phone/e-mail is at the back of this manual) if any parts are missing or damaged. **DO NOT** contact your place of purchase as they will not be able to help you.

RESISTORS

Qty	Symbol	Description	Color Code	Part #
<input type="checkbox"/> 1	R6	200Ω 5% ¼W	red-black-brown-gold	132000
<input type="checkbox"/> 1	R1	620Ω 5% ¼W	blue-red-brown-gold	136200
<input type="checkbox"/> 1	R5	3.9kΩ 5% ¼W	orange-white-red-gold	143900
<input type="checkbox"/> 1	R7	8.2kΩ 5% ¼W	gray-red-red-gold	148200
<input type="checkbox"/> 1	R8	10kΩ 5% ¼W	brown-black-orange-gold	151000
<input type="checkbox"/> 1	R4	22kΩ 5% ¼W	red-red-orange-gold	152200
<input type="checkbox"/> 1	R9	100kΩ 5% ¼W	brown-black-yellow-gold	161000
<input type="checkbox"/> 1	R2	10kΩ Potentiometer		192531
<input type="checkbox"/> 1	R3	100kΩ Potentiometer		192612

CAPACITORS

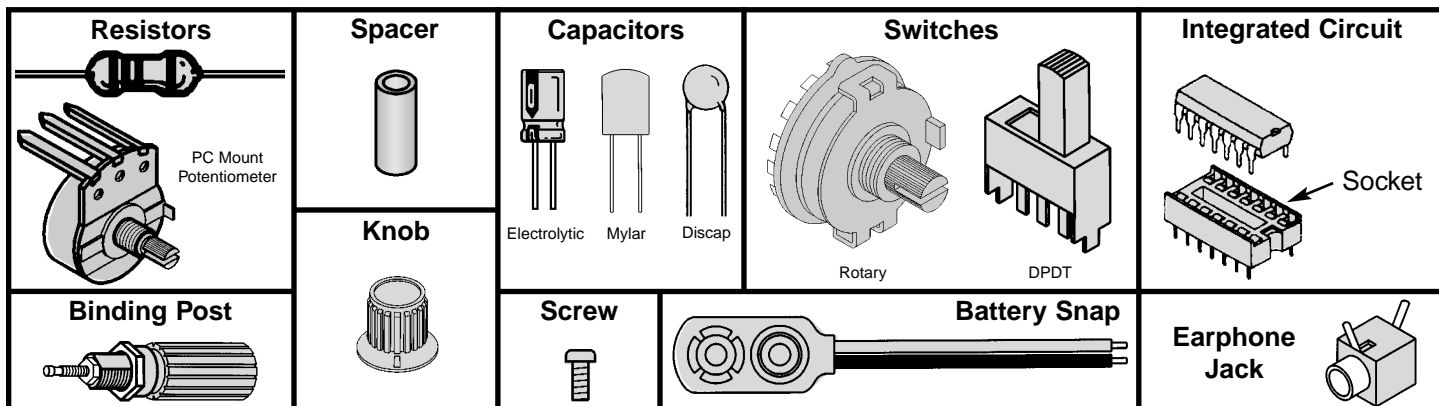
Qty	Symbol	Value	Description	Part #
<input type="checkbox"/> 1	C6	820pF (821) 10%	Discap	228210
<input type="checkbox"/> 1	C5	.01μF (103) 10%	Mylar	241017
<input type="checkbox"/> 1	C4	.1μF (104) 10%	Mylar	251017
<input type="checkbox"/> 1	C3	1μF 50V	Electrolytic (Lytic)	261047
<input type="checkbox"/> 3	C2, C7, C8	10μF 16V	Electrolytic (Lytic)	271015
<input type="checkbox"/> 1	C1	100μF 16V	Electrolytic (Lytic)	281044
<input type="checkbox"/> 1	C9	1,000μF 16V	Electrolytic (Lytic)	291044

SEMICONDUCTORS

Qty	Symbol	Value	Description	Part #
<input type="checkbox"/> 1	U1	XR-2206	Integrated Circuit	332206

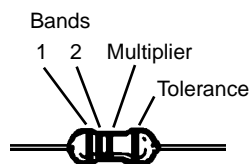
Qty	Description	Part #	Qty	Description	Part #
<input type="checkbox"/> 1	PC Board	511003	<input type="checkbox"/> 2	Binding Post Yellow	625034
<input type="checkbox"/> 2	DPDT Switch PC Mount	541009	<input type="checkbox"/> 4	Screw 4-40 x ¼" Phillips	641433
<input type="checkbox"/> 1	Switch Rotary 2p6pos	542207	<input type="checkbox"/> 3	Hex Nut 7mm	644101
<input type="checkbox"/> 1	Battery Snap	590098	<input type="checkbox"/> 1	Hex Switch Nut 9mm	644102
<input type="checkbox"/> 1	Top Panel	614111	<input type="checkbox"/> 2	Flat Washer 8mm x 14mm	645101
<input type="checkbox"/> 3	Knob	622009	<input type="checkbox"/> 1	Flat Washer 9mm	645103
<input type="checkbox"/> 1	Jack Ear Phone with Nut	622130	<input type="checkbox"/> 1	16-pin IC Socket	664016
<input type="checkbox"/> 1	Case	623003LP	<input type="checkbox"/> 1	Handle	666600
<input type="checkbox"/> 2	Spacer 5/8"	624432	<input type="checkbox"/> 2"	Weather Strip	790007
<input type="checkbox"/> 1	Binding Post Black	625031	<input type="checkbox"/> 1.5'	Black Wire 22ga.	814120
<input type="checkbox"/> 3	Nut Binding Post	625031HN	<input type="checkbox"/> 1	Solder	9ST4
<input type="checkbox"/> 3	Lockwasher Binding Post	625031LW			

PARTS IDENTIFICATION



IDENTIFYING RESISTOR VALUES

Use the following information as a guide in properly identifying the value of resistors.



BAND 1 1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

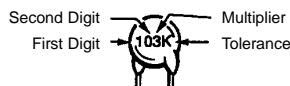
BAND 2 2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Multiplier	
Color	Multiplier
Black	1
Brown	10
Red	100
Orange	1,000
Yellow	10,000
Green	100,000
Blue	1,000,000
Silver	0.01
Gold	0.1

Resistance Tolerance	
Color	Tolerance
Silver	$\pm 10\%$
Gold	$\pm 5\%$
Brown	$\pm 1\%$
Red	$\pm 2\%$
Orange	$\pm 3\%$
Green	$\pm .5\%$
Blue	$\pm .25\%$
Violet	$\pm .1\%$

IDENTIFYING CAPACITOR VALUES

Capacitors will be identified by their capacitance value in pF (picofarads), nF (nanofarads) or μF (microfarads). Most capacitors will have their actual value printed on them. Some capacitors may have their value printed in the following manner.



Multiplier	For the No.	0	1	2	3	4	5	8	9
		Multiply By	1	10	100	1k	10k	100k	.01

The above value is $10 \times 1,000 = 10,000\text{pF}$ or $.01\mu\text{F}$

The letter K indicates a tolerance of $\pm 10\%$

The letter J indicates a tolerance of $\pm 5\%$

Note: The letter "R" may be used at times to signify a decimal point; as in 3R3 = 3.3

INTRODUCTION

Assembly of your FG-500 Function Generator will prove to be an exciting project and give much satisfaction and personal achievement. The FG-500 contains a complete function generator capable of producing sine, square and triangle wave forms. The frequency of this generator can be continuously varied from 1Hz to 1MHz in 6 steps. A fine frequency control makes selection of any frequency in between easy. The amplitude of the wave forms are adjustable from 0 to 3Vpp. This complete function generator system is suitable for experimentation and applications by the student. The entire function generator is comprised of a single XR-2206 monolithic IC and a limited number of passive circuit components.

SPECIFICATIONS

OUTPUT:

- Waveforms: Sine, Triangle, Square
- Impedance: $600\Omega \pm 10\%$.
- Frequency: 1Hz - 1MHz in 6 decade steps with variable ranges.

SINE WAVE:

- Amplitude: 0 - 3Vpp at 9VDC input.
- Distortion: Less than 1% (at 1kHz).
- Flatness: $\pm 0.05\text{dB}$ 1Hz - 100kHz.

SQUARE WAVE:

- Amplitude: 8V (no load) at 9VDC input.
- Rise Time: Less than 50ns (at 1kHz).
- Fall Time: Less than 30ns (at 1kHz).
- Symmetry: Less than 5% (at 1kHz).

TRIANGLE WAVE:

- Amplitude: 0 - 3Vpp at 9VDC input.
- Linearity: Less than 1% (up to 100kHz).

POWER REQUIREMENTS:

- Standard 9V Battery or 9V to 18VDC at input.

OPERATING TEMPERATURE:

- 0°C TO 50°C.