MODEL 635

PRECISE

PRECISE DEVELOPMENT CORP.
Oceanside, L. I., N. Y.

Your MODEL 635 UNIVERSAL AF SINE, SQUARE AND PULSE GENERATOR is another example of "an engineered product" by PRECISE.
The instrument was primarily designed to provide the necessary signals for Audio and Video testing. The circuits and components used were selected to insure the purest of waveforms and the greatest degree of stability. These circuits, many of them PRECISE exclusives, have been time and laboratory tested. Each section is completely decoupled including such innovations as cascaded CATHODE FOLLOWERS, DC AMPLIFIERS and a specially designed WIEN BRIDGE. It is engineering of this type which protects our customer while giving him the finest instruments at the lowest possible cost.

ELECTRICAL SPECIFICATIONS:

POWER	30 WATTS			
VOLTAGE	105-125 VOLTS			
LINE FREQUENCY	60 CYCLES			
RANGES	20	to	40	CYCLES
	40	"	200	"
	200	"	2,000	"
	2,000	"	20,000	"
	20,000	"	200,000	"
	Pulses and square waves thru 30,000			"
TUBES	1 - 6AU6			
	3 - 6SN7			
	1 - 6X5			
	1 - 6S6			

MECHANICAL SPECIFICATIONS:

HEIGHT	8"
WIDTH	11"
DEPTH	5"
WEIGHT	10 LBS
PANEL	SLATE GREY, DEEPLY ETCHED ALUMINUM WITH RAISED NUMERALS
CABINET	BAKED, WRINKLE GREY STEEL
HANDLE	GENUINE LEATHER
FITTINGS	COAXIAL TYPE

OPERATION:

POWER ON: Insert the line cord into any 110 volt,60 cycle line and turn the power on by rotating the Z OUT switch to any position other than POWER OFF.

STABILIZATION: The instrument may be used as soon as it is turned on for most general purposes. It is suggested, however, that at least a half hour be allowed if measurements demanding extreme accuracy are to be made.

CONTROLS: 1- Z OUT. This control varies the output impedance of the instrument for impedance matching purposes. The highest voltage output is normally found with the control in the 2,000 ohm position.

2- OUTPUT. The OUTPUT control varies the amount of voltage to the output leads. This, in no way, will vary the impedance out since a separate tube was incorporated, as one of the CATHODE FOLLOWERS, to prevent attenuator impedance variation.

3- SELECTOR. The SINE, SQUARE or PULSE positions determine the output signal waveform.

4- AF BAND. This control selects the desired range.

5- MAIN TUNING. This control tunes the instrument to the desired frequency.

SINE WAVE OUTPUT:

CONTROL	SET TO	REMARKS
Z OUT	ANY POSITION	NORMALLY 2,000
OUTPUT	MAXIMUM	VARY, AS REQUIRED
SELECTOR	SINE	
AF BAND	DESIRED RANGE	
MAIN TUNING	DESIRED FREQUENCY	

Note: Connect the output leads to the device to be tested. Never connect to any circuit which already has voltage applied unless an isolation condenser is used in series with the output lead.

SQUARE WAVE OUTPUT:

Arrange settings as above, except for the SELECTOR switch which should be placed in the SQUARE position.

PULSE OUTPUT:

Arrange settings as above, except for the SELECTOR switch which should be placed in the PULSE position.

TESTING THE FREQUENCY CHARACTERISTIC OF AN AMPLIFIER WITH SINE WAVES:

1- Set the controls on the instrument as described in the section "SINE WAVE OUTPUT". Connect the output of the 635 to the input of the amplifier.

2- Starting with the lowest frequency to be used, measure the output voltage of the amplifier with a voltmeter, VTVM or oscilloscope. Record the reading. If an oscilloscope is used, the amplitude may be measured with a ruler.

3- Proceed up in frequency while recording each voltage for each setting. The very low and very high frequencies require many check points, while the center frequencies are usually fairly flat.

4- Plotting the values obtained will show the relative amplifier response.

TESTING THE PHASE SHIFT CHARACTERISTICS OF AN AMPLIFIER WITH SINE WAVES.

1- Set the controls on the instrument as described in the section "SINE WAVE OUTPUT".

2- Connect the output of the amplifier to the HORIZONTAL INPUT TERMINALS of an oscilloscope; the output of the 635 connects to both the input of the amplifier and the VERTICAL INPUT TERMINALS of the oscilloscope.

3- This allows the signal being fed into the amplifier to be compared with the signal coming out. By Lissajous Figures, the phase shift in the amplifier may be determined for each particular frequency applied. The phase shift may be ascertained by using the Diagram previously shown entitled "LISSAJOUS FIGURE SHOWING A ONE TO ONE RATIO".

Note: It is suggested that the phase shift, inherent to the oscilloscope itself, be tested before analyzing the amplifier. This may simply be accomplished by feeding the same signal to both the HORIZONTAL and VERTICAL AMPLIFIERS of the oscilloscope simultaneously and observing the pattern produced for each particular frequency to be used.

SIGNAL INSERTION METHOD OF TROUBLE SHOOTING AN AMPLIFIER

Signal insertion is one of the most powerful methods of determining a difficulty in an amplifier. Basically it consists of starting from the last stage of an amplifier and gradually progressing toward the front, or first stage, while inserting a signal and recording the gain. If the gain should not increase properly, or the signal becomes distorted, the trouble is usually between the portion where the signal was properly fed out and the section where the distortion was noticed.

TESTING THE FREQUENCY CHARACTERISTIC OF AMPLIFIERS WITH SQUARE WAVES

Servicemen, designers and engineers are continuously striving for more effective methods of analyzing circuits. One such method, which has been around electronics for a long time, but has not until recently received universal use, is that which uses SQUARE WAVES and PULSES.
The reason for this popularity grew out of television and the use of broad band amplifiers. The methods described under the SINE wave section actually do the required job, but they are, in general, laborious and require elaborate curve plotting.
The insertion of a SQUARE WAVE into an amplifier, if properly analyzed, will immediately tell a great deal about the internal workings. The following general facts can be told at a glance.

1- The low frequency response.
2- The high frequency response.
3- The presence of resonant or tuned circuits.
4- If the amplifier is differentiating.
5- If the amplifier is integrating.

SOME FACTS ABOUT A SQUARE WAVE: A square wave is actually a rectangular wave where both half cycles have the same widths. Mathematically it consists of a FUNDAMENTAL frequency and HARMONICS of that frequency. (A harmonic is a multiple. The 1st harmonic of 60 cycles is 60 cycles; called the fundamental. The 2nd harmonic is 120 cycles. The 3rd is 180 cycles and so on). The square wave theoretically consists of a fundamental and an infinite number of odd harmonics. In actual practice, however, the important harmonics are the fundamental up through about the 11th term.
Since the square wave is actually a whole series of waves added together in proper phase and size, it seems logical that phase or amplitude distortion would cause the waveform of the square wave to change. This actually is the case.
This may be dynamically demonstrated by performing the following simple experiments:
1- Set up the circuit of Figure 1. Note how the top and bottom portions of the wave slope down from their peak values. This is LOW FREQUENCY DISTORTION where the high frequencies are being passed properly and the lows are being phase-shifted and their amplitudes reduced. This may be eliminated by either raising the value of the condenser or resistor. As a further experiment, change the resistor to 100K and notice how the signal is improved.

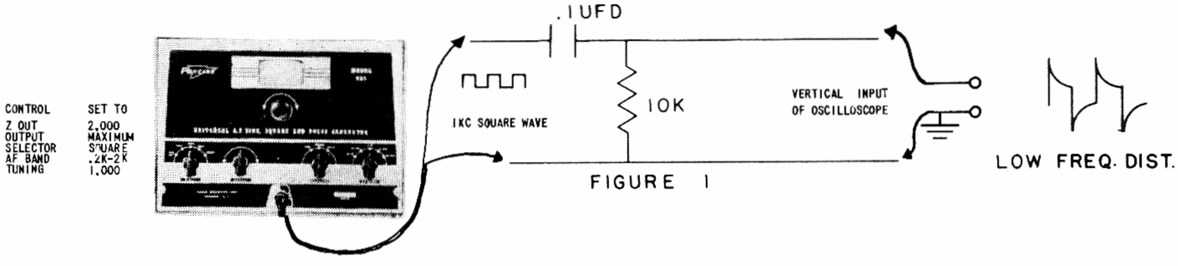


FIGURE 1

2- Set up the circuit of Figure 2. Note how the leading edges are rounded-off. This is HIGH FREQUENCY DISTORTION where the lows are going through properly, but the highs are being distorted. This may be eliminated by removing the .1 ufd bypass condenser. This is similar to the case where the distributed capacity of a circuit causes a loss in the high frequencies.

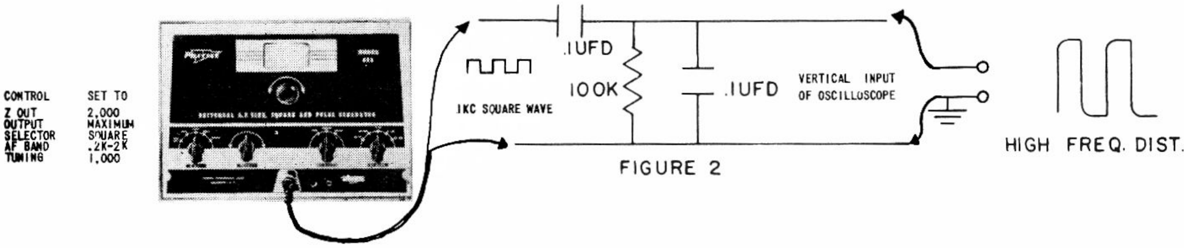


FIGURE 2

3- Set up the circuit of Figure 3. This is an extreme case of Figure 1. The resulting pulses are what is normally called DIFFERENTIATION. If a small Germanium rectifier were placed across the 10K resistor, the positive or negative pulses could be removed.

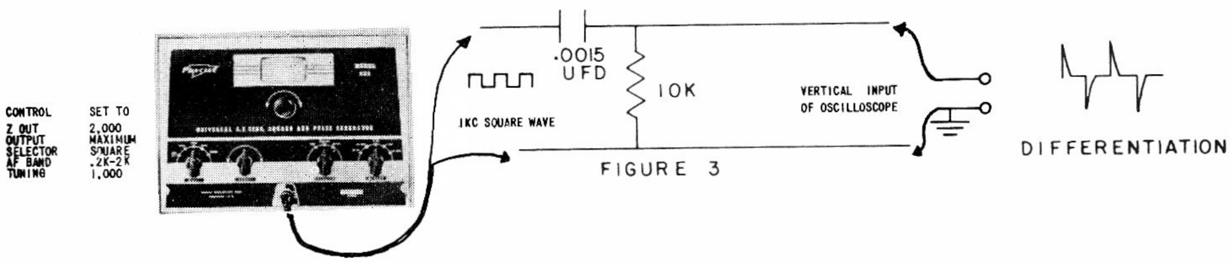


FIGURE 3

4- Set up the circuit of Figure 4. This is called an INTEGRATOR and is the standard method of developing a triangular wave. The electronics of the circuit is fairly simple. The TIME CONSTANT of the resistor & condenser combination is fairly long. The leading edge shows the charging of the condenser while the lagging edge shows the discharging and then charging negatively.

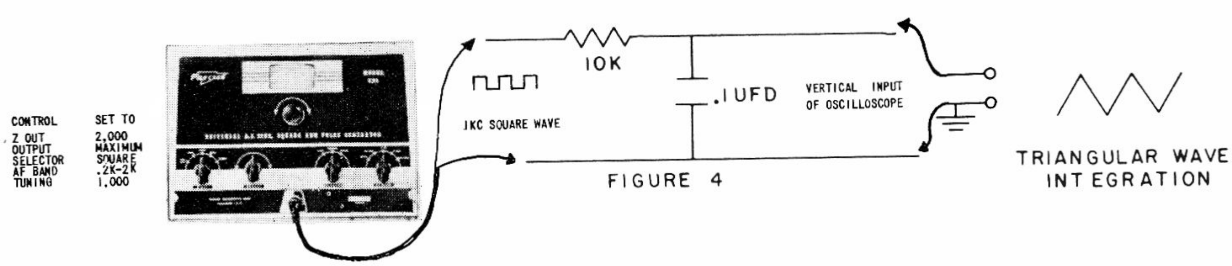


FIGURE 4

There are many circuits that may be used to compensate for various types of distortion in amplifiers. Low frequency distortion is most often adjusted with LOW FREQUENCY COMPENSATION circuits placed in the plate circuit of an amplifier if increasing the size of the coupling condensers and grid-leak resistors does not do the job.

High frequency compensation is usually a bit more complicated and requires series or shunt peaking circuits.

The most important fact here, however, is that proper analysis of the type of trouble is the most direct method towards its solution.

DEVELOPING SPECIAL WAVEFORMS: It is veritably impossible to provide one instrument with all the possible combinations of waveforms which might be desired. It is possible, however, to provide the basic instrument for that purpose. Your MODEL 635 with the addition of simple RC circuits, as previously described, may be used as the basis for any number of waveforms.

CIRCUIT DESCRIPTION:

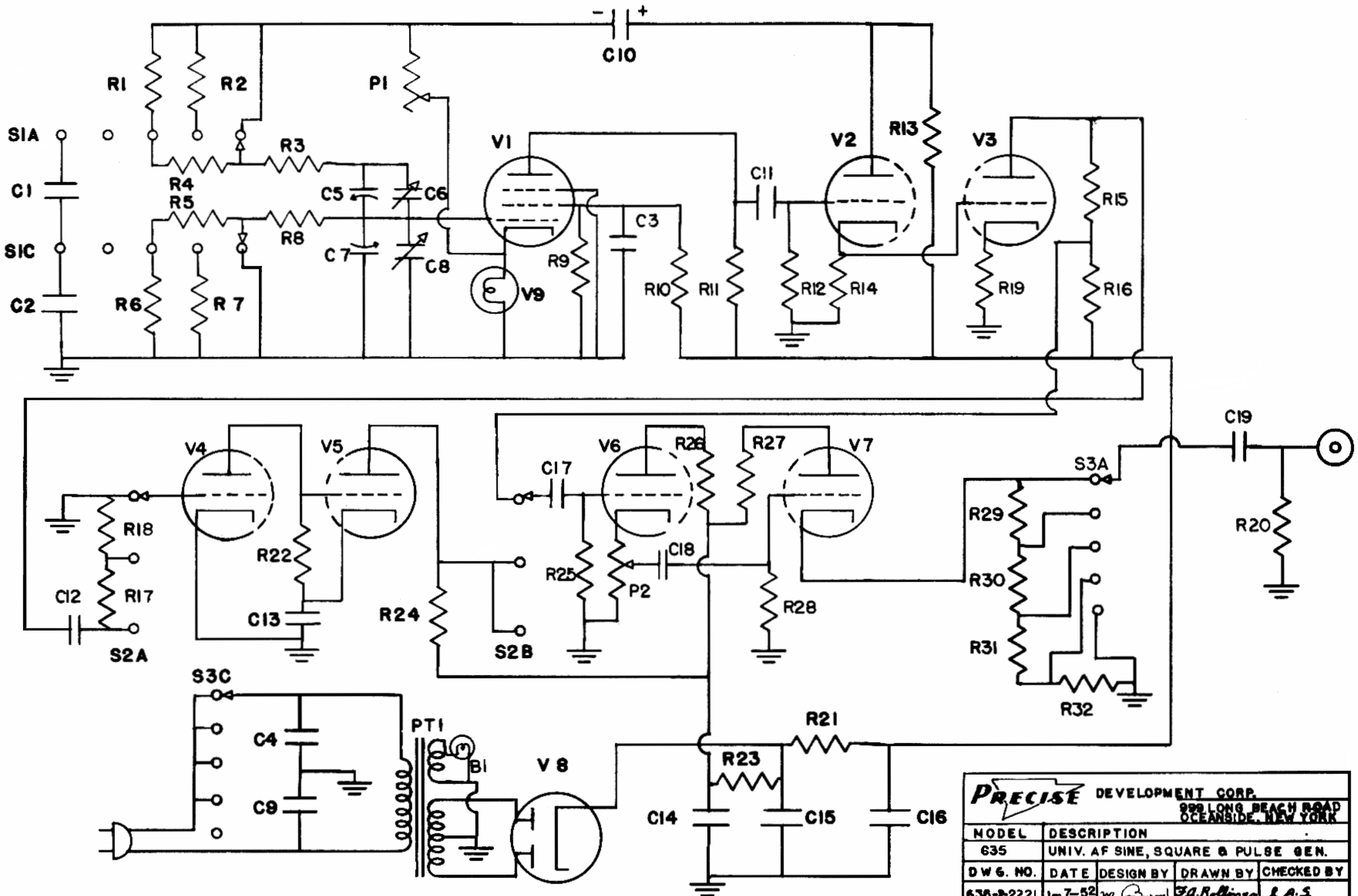
A Wien Bridge oscillator, consisting of tubes V1, V2 & V9, develops the sine wave. From V2 the signal is fed into DC amplifier V3 which acts as both an isolation and distribution circuit for the bridge. From V3 the signal is fed to V4 (the first shaping circuit) and then to V5 (the 2nd shaping circuit). From V5 the signal is fed into V6 which is both the 3rd shaping circuit and cathode follower attenuator circuit. It is then transferred to V7 which is the impedance transforming and output circuit. From V7 the signal is connected to the coaxial output connector.
In the SINE position, tubes V4 & V5 are removed from the circuit.

WIEN BRIDGE OSCILLATOR: This circuit is basically a two-stage amplifier with both positive and negative feedback applied to the first tube. The negative feedback is overcome when the bridge is balanced by a particular frequency. Since the bridge circuit is composed of components which are very slightly affected by heat, etc. the circuit is extremely stable.

WARRANTY:

All merchandise is warranted to be free from defects in material and workmanship and is fully protected by the standard RMA GUARANTEE.

SCHEMATIC



PRECISE DEVELOPMENT CORP. 999 LONG BEACH ROAD OCEANSIDE, NEW YORK				
MODEL	DESCRIPTION			
635	UNIV. AF SINE, SQUARE & PULSE GEN.			
DWG. NO.	DATE	DESIGN BY	DRAWN BY	CHECKED BY
635-2-2221	1-7-52	M. Byrd	F.A. Rollings	S. A. S.
REVISIONS				

DESCRIPTION	PART#	AM"T
Pilot Light (small)	B1	1
370 uufd Condenser	C1	1
" " "	C2	1
57 " "	C3	1
.0015 ufd "	C4	1
Variable Condenser	C5-8	1
.0015 ufd "	C9	1
20 or 24 ufd"	C10	1
.1 ufd "	C11	1
.25 " "	C12	1
20x20 ufd "	C13-14	1
" " " "	C15-16	1
.5 " "	C17	1
.25 " "	C18	1
50 " "	C19	1
2,000 ohm Potentiometer	P1	1
" " "	P2	1
Power Transformer	PT1	1
1.8M 1% Res	R1	1
163.6K 1% Res	R2	1
18K " "	R3	1
8M " "	R4	1
" " "	R5	1
1.8M 1% "	R6	1
163.6K " "	R7	1
18K " "	R8	1
56K Resistor	R9	1
100K "	R10	1
" "	R11	1
1.2M "	R12	1
10K "	R13	1
1K "	R14	1
47K "	R15	1
20K "	R16	1
470K "	R17	1
" "	R18	1
6.8K "	R19	1
47K "	R20	1
2.2K " 1 Watt	R21	1
3.3K Resistor	R22	1
" " 1 Watt	R23	1
10K Resistor	R24	1
1.2M "	R25	1
10K "	R26	1
" "	R27	1
5.6M "	R28	1
1.5K "	R29	1
330 Ohm Resistor	R30	1
100 " "	R31	1
" " "	R32	1
5 Position Switch	S1	1
3 " "	S2	1
5 " "	S3	1
6AU6 Tube	V1	1
6SN7 "	V2-3	1
" "	V4-5	1
" "	V6-7	1
6X5 "	V8	1
6S6 "	V9	1

You have now completed the construction and wiring of your MODEL 635.A few more points of CAUTION here may save the waiting time for replacement parts.

1- Check over the entire assembly. Make certain that all connections are properly soldered; that rosin has not caused leakage between pin or switch contacts; that there are no rosin joints. Do this in an organized way, starting from one end of chassis and gradually progressing to the other side while examining all connections.

2- Check the resistance from pin 8 of the 6X5 (V8) to ground. This should be at least 30,000 ohms and the ohm-meter needle should show the gradual charging of the electrolytic condensers. If a lower resistance is observed, DO NOT TURN SET ON, but recheck the power supply wiring.

Check the resistance from the frame of the variable condenser to ground. This should be at least 9 megohms when the SELECTOR SWITCH is in the 40-200 position. If a lower resistance, or a direct short appears, check the Fibre Washers on the spade lug mounting of the variable condenser.

3- Plug the line cord into any 110 volt, 50 or 60 cycle line. Turn power on by rotating the Z OUT switch to the 2,000 position. The small pilot light should light immediately. If it does not, turn power off AT ONCE and recheck filament wiring.

CALIBRATION: The calibration of this instrument is extremely simple and actually only consists of three adjustment controls: a) the potentiometer(P1) which adjusts the output waveform; b) trimmers C6 & C8 which adjust the frequency.
The surest method of calibration employs an oscilloscope, although an AC Voltmeter may be used as an approximate method. Both systems are explained herein.
A warm-up period, of about two hours, should be allowed before calibration, although you may start at once and "touch-up" the adjustments later on.

CALIBRATION WITH AN AC VOLTMETER: Note - If an oscilloscope is available, disregard this procedure and go directly to the section marked CALIBRATION WITH AN OSCILLOSCOPE.
1- Set all controls as follows:

CONTROL	SET TO
Z OUT	2,000
OUTPUT	MAXIMUM CLOCKWISE
SELECTOR	SINE
AF BAND	40-200
MAIN TUNING	MAXIMUM COUNTERCLOCKWISE

2- Connect one lead of an AC VOLTMETER (preferably 1,000 ohms/volt or more) to pin 6 of V2 (Pin 6 of the 6SN7 low loss molded socket , H7). The other lead goes to chassis ground.

3- Adjust potentiometer (P1) for approximately 3.75 volts rms. The usual AC meter is calibrated in rms voltages.

4- Loosen the trimmer adjustment screw for C7 until it is almost all the way out. (C7 is located from the bottom of the chassis through hole #24 as shown in Diagram #10).

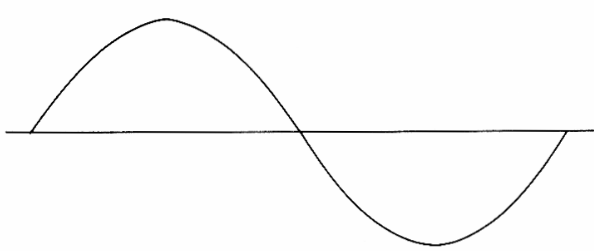
5- Rotate the TUNING control to its maximum clockwise position (high frequency end of the band) and adjust the trimmer for C5 until the voltage is again approximately 3.75 volts. (C5 is located from the bottom of chassis through hole #25 as shown in Diagram 10). An insulated alignment tool should be used for these adjustments.

6- This approximately aligns the instrument. For a more exact alignment the oscilloscope method should be used. The instrument, however, should be accurate enough for general purpose uses. The greatest accuracy will normally be found on the lowest frequency portions of each band. The highs require the oscilloscope method.

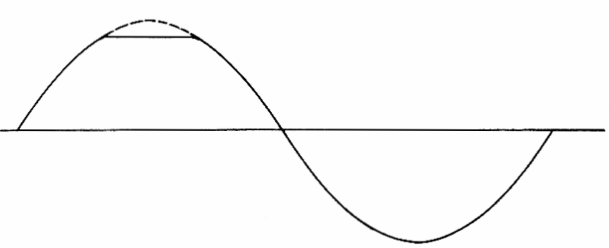
CALIBRATION WITH AN OSCILLOSCOPE: 1- Set all controls as shown in step 1 of CALIBRATION WITH AN AC VOLTMETER.

2- Connect the output leads of the MODEL 635 to the vertical amplifier input terminals of the oscilloscope.

3- Adjust P1 (located on the chassis) until an undistorted pattern appears on the screen of the oscilloscope. Best results may be obtained by adjusting the scope's internal sweep until two patterns appear simultaneously. Distortion is recognized by a flattening off on the top and/or bottom of the SINE wave. Adjust P1 until the distortion just disappears; be careful not to adjust down too far as this could cause instability. Note: If a slight wavering of the signal is noticed, it is probably caused by stray pickup and should be eliminated when placed into the cabinet.



SINE WAVE WITHOUT DISTORTION



SINE WAVE WITH DISTORTION ON TOP

Dotted line indicates direction of a pure sine wave

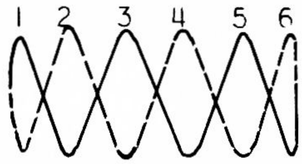
4- Loosen the trimmer adjustment screw for C7 until it is almost all the way out. (C7 is located from the bottom of the chassis through hole #24 as shown in Diagram #10).

5- Rotate the TUNING control to its maximum clockwise position (highest frequency) and adjust the trimmer for C5 until the height is approximately the same as was seen in step 3. The trimmer for C5 is located from the bottom of the chassis through hole #25 Diagram 10. This approximately aligns the generator.

6- For exact alignment, rotate the TUNING control to the position marked 'CALIBRATION POINT' on the 40-200 scale

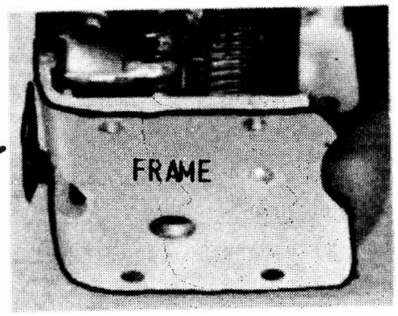
7- Feed a 60 cycle signal to the HORIZONTAL AMPLIFIER terminals of the oscilloscope and change the sweep setting to the HORIZONTAL AMPLIFIER position. If the oscilloscope has a 60 cycle position on the sweep switch, use that.

8- Adjust trimmer C5 until a Lissajous figure* as shown below appears. Note that it has 6 peaks on top; this means that the unknown is 6 times the frequency of the known or 360 cycles. The CALIBRATION POINT, therefore, is to be adjusted for 360 cycles. Note: If the picture rotates slightly, it should not be of too much concern. If the signal amplitude drops down considerably on the CALIBRATION POINT, remove the trimmer screw from C7 and bend the trimmer plate completely open (270 degrees) so that it is flat up against the variable condenser frame To do this, it may be necessary to loosen the nuts holding the variable condenser to the chassis.

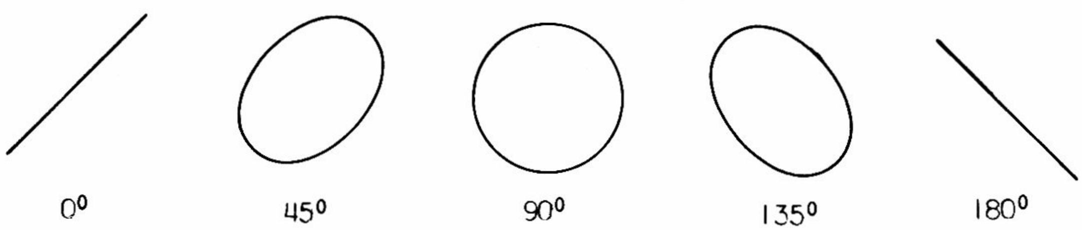


LISSAJOUS FIGURE
SHOWING 6 TO 1 RATIO

TRIMMER BENT BACK



9- Without changing the setting on the oscilloscope, turn the main tuning knob on the MODEL 635 until the Dial reads 60 cycles. A circle should appear. This again is a Lissajous figure and since it has only one peak, the unknown and known are at the same frequency. i.e. 60x1 = 60.



LISSAJOUS FIGURE SHOWING A ONE TO ONE RATIO

If both frequencies are not exactly the same, the figure will rotate through the various patterns shown above.

If the 60 cycle point does not come in properly, loosen the 3/8" I.D. nut holding the Dial Drum to the small PULLEY and rotate the Drum, without changing the position of the variable condenser, until the 60 cycle point is set. Tighten the 3/8" nut and repeat steps 6,7 & 8 above.

10- The other ranges should be properly calibrated since only precision components are used in the frequency determining bridge circuit. If distortion is noticed on any other range, a slight adjustment of P1 should rectify the trouble. It is suggested that the instrument be used for about a month and then a final calibration should be made. This gives all the major components a chance to properly stabilize after aging.

11- The Square Wave and Pulse positions do not require any special calibration.

GENERAL: 1- Insert into cabinet, threading the line cord thru the large hole in the rear of the cabinet; secure with two Acorn nuts in back and four self-tapping screws in front.

SERVICING: In the event of difficulty, recheck the wiring carefully. Most troubles may be immediately traced to wiring mistakes, rosin joints, rosin between contacts or shorts.

FACTORY REPAIR: If a question should arise, write to our Engineering Department listing all possible readings, etc. which may aid in analyzing the problem. Your letter will be answered promptly. The instrument may, if you so desire, be returned to the factory for final repair and calibration at a service charge of $5.50. This does not include the cost of parts that may have been damaged due to misuse. Pack carefully and use the original carton, if possible. SHIP EXPRESS PREPAID. Make certain all parts are secured tightly in place.

* LISSAJOUS FIGURES: By feeding a known frequency signal (in this case 60 cycles) to one set of deflection plates of an oscilloscope and an unknown frequency to the other set of plates, the unknown frequency may be determined by examination of the resultant picture.

DIAGRAM 10 CHASSIS BOTTOM VIEW

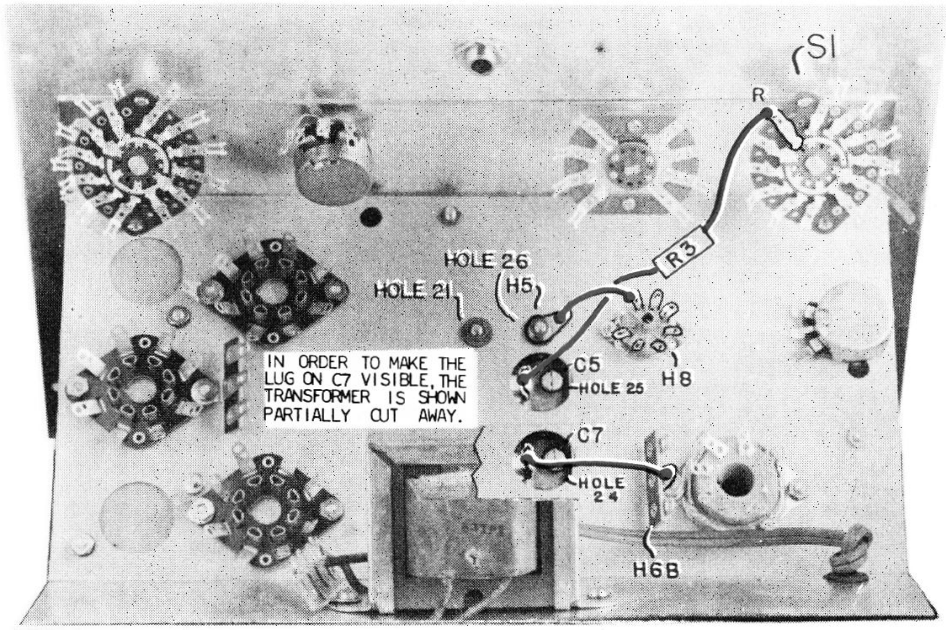


DIAGRAM 11 - CHASSIS TOP VIEW