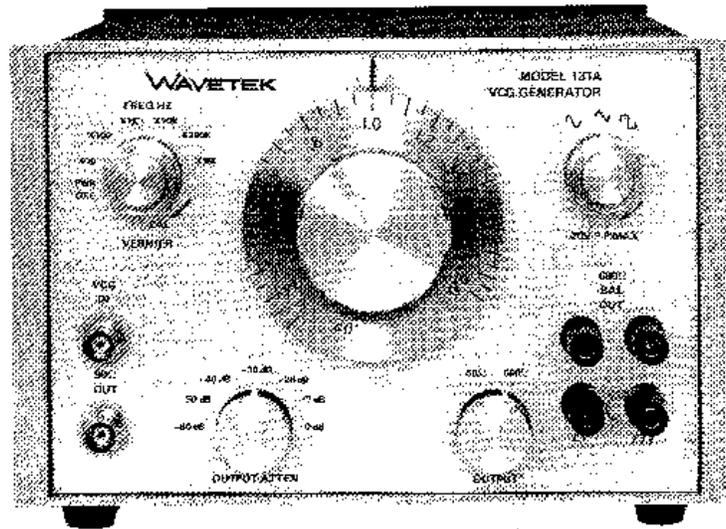


INSTRUCTION MANUAL

MODEL 131A VCG GENERATOR



WAVETEK

Product Improvement Notice

Wavetek maintains a continuing program to make improvements to their instruments that will take advantage of the latest electronic developments in circuitry and components.

Due to the time required to document and print instruction manuals, it is not always possible to incorporate these changes in the manual.

Wavetek has manufactured your instrument, using metal film 1% tolerance resistors in place of 5% carbon resistors, wherever practical. This results in a substantial improvement in the overall performance of your instrument. Therefore, there may exist a discrepancy between the resistor used to manufacture your instrument and the resistor called out in the Parts List and Schematic Diagrams in this manual.

If field replacement of an affected resistor does become necessary, replacement may be made in accordance with the manual call outs. Wavetek, however, recommends replacement with the same type of resistor used in the manufacture of your instrument, whenever possible.

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All Wavetek instruments are warranted against defects in material and workmanship for a period of one year after date of manufacture. Wavetek agrees to repair or replace any assembly or component (except batteries) found to be defective, under normal use, during this period. Wavetek's obligation under this warranty is limited solely to repairing any such instrument which in Wavetek's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by purchaser. Shipment should not be made without prior authorization by Wavetek.

This warranty does not apply to any products repaired or altered by persons not authorized by Wavetek, or not in accordance with instructions furnished by Wavetek. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, repairs will be billed at cost.

Wavetek assumes no responsibility for its product being used in a hazardous or dangerous manner either alone or in conjunction with other equipment. High voltage used in some instruments may be dangerous if misused. Special disclaimers apply to these instruments. Wavetek assumes no liability for secondary charges or consequential damages and, in any event, Wavetek's liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

Any recommendations made by Wavetek for use of its products are based upon tests believed to be reliable, but Wavetek makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Wavetek any liability in connection with the sale of our products other than set forth herein.

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SCOPE OF MANUAL

This manual contains instructions for operating, testing, and maintaining the Wavetek Model 131 and the 131A VCG Generator. The 131A is identical to the 131 with the addition of a step attenuator and a output impedance selector switch. The Wavetek product-improvement program ensures that the latest electronic developments are incorporated into the Wavetek instruments by the addition of circuit and component changes as rapidly as development and testing permit. Due to the time required to document and print these Instruction Manuals, it is not always possible to get these changes incorporated into the

manual. In this case, data will be found on engineering change sheets at the back of the manual. If there are no change sheets, the manual is correct as printed.

SCOPE OF EQUIPMENT

The Model 131A is a precision source of sine, square, and triangle waveforms, with selectable and variable outputs over a dynamic frequency range of 0.2 Hz to 2 MHz. It can be manually operated with easy-to-use, front-panel controls and also offers frequency control by external voltage for either dc programming of wideband ac FM applications.

SECTION 1

SPECIFICATIONS

VERSATILITY

Waveforms

Sine , square , and triangle 

Dynamic Frequency Range

50 Ω OUT	0.2 Hz to 2 MHz
600 Ω BAL OUT	0.2 Hz to 20 kHz
600 Ω BAL OUT	Usable to 2 MHz

Ranges

X10	0.2 Hz to 20 Hz
X100	2 Hz to 200 Hz
X1K	20 Hz to 2 kHz
X10K	200 Hz to 20 kHz
X100K	2 kHz to 200 kHz
X1M	20 kHz to 2 MHz

Outputs

Sine , square , and triangle , selectable; output is controlled with 60 dB step attenuator in 10 dB steps with overlapping vernier control. 50 Ω output impedance, 20 V p-p into open circuit and 10 V p-p into 50 Ω load from 50 Ω source impedance. 600 Ω output impedance balanced with center tap; 20 V p-p into open circuit and 10 V p-p into 600 Ω balanced load from 600 Ω balanced source impedance. Short circuit current is ± 100 milliamperes.

NOTE

When 600 Ω BAL OUT is used as a balanced output, the instrument signal common may not be tied to any external signal common unless the common is completely floating and no dc path exists to the 131A common (BNC shell).

Sync Output

Greater than 1 V p-p square wave into open circuit at 600 Ω output impedance.

DC Offset

± 5 V offset (± 2.5 V offset into 50 Ω load or 600 Ω balanced load) controlled from rear panel; peak amplitude limited by the dynamic range of the amplifier output. DC offset voltage as well as waveform is proportionally attenuated by the step attenuator.

VCG—Voltage Controlled Generator

Frequency of generator may be dc-programmed or ac-modulated by external 0 to 5 V signal. Voltage control circuitry is capable of 1000:1 deviation of the output frequency. The VCG amplifier has a 100 kHz bandwidth and a slew rate of 0.1 V/ μ sec. The instantaneous frequency is the result of the sum of the dial setting and the externally applied voltage.

Stability

Short term $\pm 0.05\%$ for 10 minutes
 Long term $\pm 0.25\%$ for 24 hours
 Percentages apply to amplitude, frequency, and dc offset.

HORIZONTAL PRECISION

Dial Accuracy

$\pm 2\%$ of full scale, 1 Hz to 2 MHz.

Electronic Frequency Vernier

One turn for approximately 1% of full scale change.

Time Symmetry

$\pm 1\%$ through X100K range.

VERTICAL PRECISION

Sine Wave Frequency Response

Amplitude change with frequency less than:
 0.1 dB from 0.2 Hz to 200 kHz
 0.5 dB from 0.2 Hz to 2 MHz

Step Attenuator Accuracy

± 0.25 dB/10 dB.

PURITY

Sine Wave Distortion

Less than:

- 0.5% on X10, X100, X1K, X10K ranges
- 1.0% on X100K range
- 2.0% on X1M range

Square Wave Rise and Fall Time

Less than 50 ns.

ENVIRONMENTAL

Temperature

All specifications listed, except stability, are for 25°C ±5°C. The generator will operate from 0°C to 55°C.

MECHANICAL

Dimensions

8½ in./21.6 cm wide, 5¼ in./13.3 cm high, 11¼ in./29.2 cm deep.

Weight

8 lb/3.6 kg net, 11 lb/4.99 kg shipping.

Power

105 V to 125 V or 200 V to 250 V, 50 Hz to 400 Hz.
Less than 15 watts

NOTES

All specifications apply for frequencies obtained when dial is between 0.1 and 2 and at 10 V p-p into a 50Ω load.

It is possible to stop the generator from oscillating by applying a negative voltage when the dial is already set at minimum frequency. Inputs up to 30 V will not permanently damage the instrument, however.

SECTION 2 OPERATION

INSPECTION

The following procedures should be performed to assure the user that the instrument has arrived at its destination in proper operating condition. Complete calibration and checkout instructions are provided in Section 4 for determining if the instrument is within electrical specifications. If your instrument is a 131, disregard any instructions pertaining to the 600Ω balanced output or the step attenuator.

Checking Visually

After carefully unpacking the instrument, visually inspect the external parts for damage to knobs, dials indicators, surface areas, etc. If damage is discovered, file a claim with the carrier who transported the instrument. Retain the shipping container and packing material for use in case reshipment is required.

Checking Electrically

NOTE

Instruments are normally shipped connected for 115 V power unless 230 V power is ordered. Refer to the end of this section for conversion instructions.

The steps in this paragraph provide a quick checkout of instrument operation. If electrical deficiencies exist, refer to the *Warranty* in the front of this manual. The following test equipment, or equivalent, is recommended for performing this electrical inspection. (Refer to Page 4 and Figure 2-2 for operating control descriptions.)

Name	Manufacturer	Model
Oscilloscope	Tektronix	544
Oscilloscope Plug in	Tektronix	1A5
Counter-Timer	Monsanto	101A

1. Turn FREQ HZ selector to the X1K position. (This connects ac power to the unit and establishes the frequency multiplier).

2. Connect oscilloscope to the 50Ω OUT connector with a 50-ohm terminator and set the 50/600Ω selector to 50Ω.
3. Set frequency dial to the 1.0 mark and the frequency vernier to CAL position.
4. Set function selector to \sim .
5. Rotate 20 V P-P MAX control to its maximum clockwise position, with the attenuator in the 0 dB setting.
6. Check for 1-kHz sine wave with greater than 10 V p-p amplitude on oscilloscope.
7. Select \square and \wedge with function selector and check for 10 V p-p amplitude on oscilloscope.
8. Turn frequency dial from maximum counterclockwise to maximum clockwise positions and check for frequency change.
9. Step the output attenuator through its range and verify attenuation at each step.
10. Rotate 20 V P-P MAX control from maximum clockwise to maximum counterclockwise positions and check for decreasing amplitude.
11. Rotate VERNIER control and check for frequency change.
12. Set VERNIER control at maximum cw and frequency dial at .02. Set frequency to 20 Hz with counter. Connect a 0 to +5 Vdc input to the VCG IN connector. Slowly increase voltage input from 0 to maximum and check that frequency of output waveform increases from approximately 20 Hz to 2 kHz.
13. Connect the 600Ω balanced output connectors to a differential input oscilloscope (Tektronix 1A5 plug-in or equivalent) as shown in Figure 2-1.
14. Set 50/600Ω selector to 600Ω.
15. Repeat steps 5 through 10.

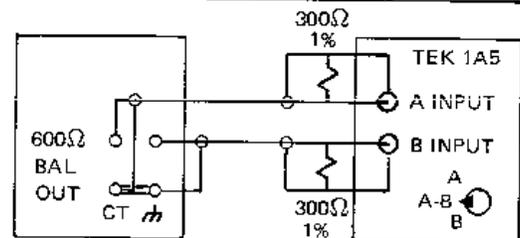


Figure 2-1. Test Set-up for 600Ω BAL

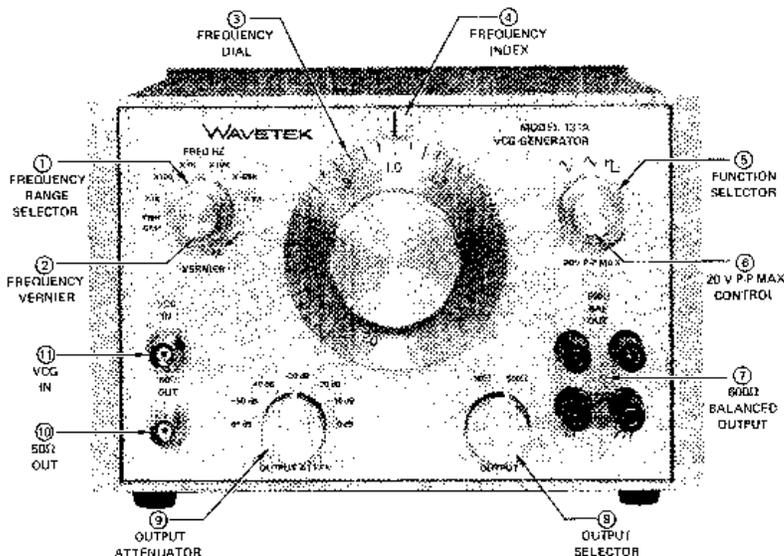


Figure 2-2. Operating Controls

OPERATING CONTROLS

The operating controls and electrical connections for the Model 131A are shown in Figure 2-2. The listing below discusses each control and its function.

1. **FREQ HZ/Power Switch** — This 7-position switch selects the generator frequency range. The extreme counter-clockwise position is the power off position.
2. **Frequency VERNIER** — This control allows precision control over the output frequency. A full turn of this control is approximately equal to one minor division of the frequency dial. When in the full clockwise position (CAL), the settings on the main dial will be calibrated.
3. **Frequency Dial** — The setting on this dial multiplied by the frequency range setting equals the output frequency of the generator. The frequency VERNIER also affects the generator frequency.
4. **Frequency Index** — The scribe line indicates the frequency dial setting. The index is illuminated when the unit is on.
5. **Function Selector** — This selects the waveform that appears at the 50Ω OUT connector. The waveforms are sine \sim , triangle ∇ , or square \square .
6. **20 V P-P Max Control** — A vernier control of the output amplitude. Maximum clockwise position gives the full output amplitude of 20 V peak-to-peak into an open circuit or 10 V p-p into a 50Ω load, for 50Ω OUT and 10 V p-p into 600 balanced load. Counter-clockwise rotation will continuously reduce the output amplitude. The control gives a minimum of 40 dB variation (100:1), and operates in conjunction with the OUTPUT ATTEN (9). For maximum amplitude output this vernier must be full clockwise, and the output attenuator in the "0 dB" position.
7. **600Ω BAL OUT** — This connector provides the selected generator output function when the 600Ω output is selected. The generator may operate into an open circuit providing 20 V peak to peak maximum or into a 600Ω balanced load providing a 10 V peak to peak output.
8. **OUTPUT Selector** — Selects the output impedance of the generator, either 50Ω floating or 600Ω balanced.

9. **Output Attenuator** — This control attenuates the output amplitude according to the following table:

Attenuator Position	Output peak to peak into 50Ω or 600Ω Balanced Load	
	Maximum Vernier full cw	Minimum Vernier*
0 dB	10 V	1 V
-10 dB	3 V	300 mV
-20 dB	1 V	100 mV
-30 dB	300 mV	30 mV
-40 dB	100 mV	10 mV
-50 dB	30 mV	3 mV
-60 dB	10 mV	1 mV

*The values in this table are approximate. The 20 V p-p max attenuator will reduce the output nearly 40 dB in all cases. This table shows only a 20 dB reduction for simplicity.

10. **50Ω OUT** — This connector provides the selected generator output function when the 50Ω output is selected. The generator may operate into an open circuit providing 20 V peak-to-peak maximum, or into a 50Ω load providing a 10 V peak-to-peak output.

11. **VCG IN** — This connector allows external control of frequency. With 0 volts in, the generator output frequency is determined by the frequency range selected and the frequency dial setting. A positive VCG voltage will increase this frequency, and a negative voltage will decrease the frequency. Input impedance is 5 kΩ.

DC OFFSET — This rear panel control adjusts the amount of DC or baseline offset above or below signal ground. The detent position gives normal vertical symmetry.

SYNC OUT — This rear panel output provides a synchronizing wave output at the same frequency of the main generator. The output amplitude is greater than 1 V p-p into open circuit at 600Ω output impedance.

OPERATION

NOTE

One-half hour warmup is required for generator to stabilize at specified accuracies.

Operating as a Function Generator

1. Select output impedance by using 50Ω/600Ω selector.
2. Properly terminate the output connector in use.

NOTE

A proper termination results in 10 V p-p maximum output level. Open-circuit termination gives 20 V p-p.

3. Set the function selector to , , or .
4. Set FREQ HZ range selector to desired multiplier.
5. Set desired frequency dial mark under illuminated index.

NOTE

The frequency VERNIER control must be in fully clockwise position for calibrated frequency operation.

6. Set OUTPUT ATTENUATOR for desired setting.
7. Set 20 V p-p max control for desired output level.

Operating as a VCG Generator

1. Set 50Ω/600Ω selector to desired output impedance.
2. Properly terminate the output signal. (50Ω or 600Ω).
3. Set function selector to , , or  as required.
4. Set FREQ HZ selector to desired multiplier.
5. Connect external voltage source (dc programming or wideband ac signal) to VCG IN connector. When using the 600Ω OUTPUT the VCG IN BNC shell must not be connected to 600Ω CT or ground. See Figure 2-5.

NOTE

VCG input requires 0 to ±5 volts for operation over full-scale range, but can withstand many times maximum input.

6. Set frequency dial as follows:
 - a. For frequency modulation with ac input, set dial for center frequency.
 - b. For increasing frequency sweep with positive dc input, set dial to lower frequency limit.

- c. For decreasing frequency sweep with negative dc input, set dial to upper frequency limit.
- 7. To sweep the audio range from 20 Hz to 20 kHz, set the controls to 20 Hz as follows:
 - a. Set the main dial at .02.
 - b. Set the frequency vernier at the full counter-clockwise position.
 - c. Introduce a 0 to +5 V ramp into the VCG input connector.
- 8. The nomograph in Figure 2-3 shows the characteristics of the VCG circuit. Column A gives the frequency dial setting; column B, the VCG input voltage; and column C, the approximate resultant dial frequency. Column C must be multiplied by the frequency range multiplier for the actual output frequency.

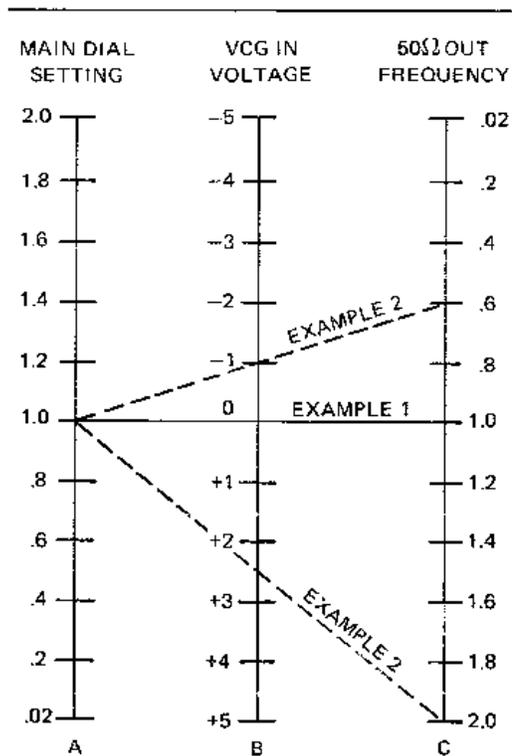


Figure 2-3 - VCG Voltage-to-Frequency Nomograph

In example 1, the dial is set at 1, and 0 volts is applied to the VCG input. Extend a straight line

6

from 1 (dial setting) through 0 volts (VCG voltage) and obtain a dial frequency of 1. For the total output frequency multiply the range by 1 with the same dial setting, example 2 shows the results of using a ramp from -1 volts to +2.5 volts for the VCG voltage. This results in a swept output from .6 to 2.0 on the dial. Remember to multiply the dial times the range.

Converting to 230-Volt Line Power

Model 131A is shipped from the factory with the power transformer connected for 115-volt line power, unless ordered for 230-volt use. Converting a 115-volt unit for 230-volt operation is a simple matter:

1. Remove power cord.
2. Loosen two captive thumb screws on rear panel and remove panel.
3. The conversion switch is located on the chassis. Use a thin-bladed screwdriver to move the 115-230 switch to the 230 position.
4. Replace 1/4-ampere fuse with a 1/8-ampere fuse of the same type.

Connecting Signal Common and Chassis Ground When Using 600Ω Balanced Output.

The instrument is shipped from the factory with the signal common floating above chassis ground in order to obtain 600Ω balanced output from a single ended output amplifier. It is important to understand the grounding of the instrument before attempting to make any external connection to the BNC connectors or binding posts.

When the 50Ω/600Ω selector is switched to 50Ω, all the BNC connector shells are connected to the signal common. When it is switched to 600Ω, it is advised to restrict the BNC connector shells from connecting to any of the four binding posts of 600Ω BAL. OUT, since the BNC shells are connected to one of the balanced signal outputs. See Figure 2-5.

Connecting Signal Common and Chassis Ground When Using 50Ω Output.

1. Remove power cord.
2. Loosen two captive thumb screws on rear panel and remove panel.
3. Solder a jumper wire between the ground lugs (green wire) of the SYNC OUT connector and the power connector (Figure 2-4).

- This connection must be removed when using the 600Ω balanced output.

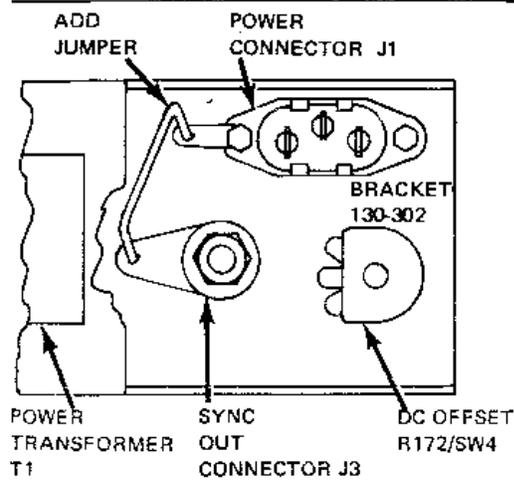


Figure 2-4. Common Ground Connection Diagram

Connecting Sync Out to an Oscilloscope

When in the 600Ω balanced mode, the SYNC OUT connector must not be connected directly to an oscilloscope since the BNC shells are connected to one of the balanced output signals. Connecting directly to the scope without isolating with a pulse transformer will cause attenuator B (see Figure 2-1) to be shorted, thus, one-half of the output impedance (300Ω) will be lost. The amplitude will remain the same, but the result is a 300Ω single ended output.

An error in signal common connection will not damage the instrument. See Figure 2-5.

The VCG IN may be connected to any ac or dc voltage source if the signal common is floating from earth ground.

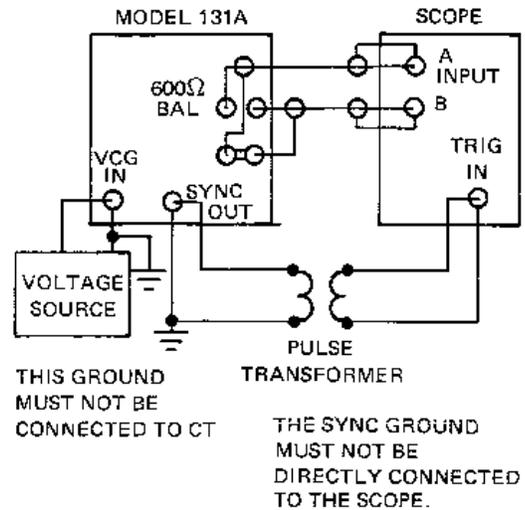


Figure 2-5. 600Ω Sync Out Connections

Connecting Chassis Ground to Center Tap

If it is desirable to balance the 600Ω output about chassis ground, connect the center tap (CT) to the chassis by placing the metal strap between CT and chassis on the binding posts.

SECTION 3

CIRCUIT DESCRIPTION

GENERAL DESCRIPTION

Refer to the block diagram of the Model 131A Function Generator, Figure 3-1.

Basically, a square wave is applied to the input of an integrator composed of a wideband differential dc amplifier, integrating resistor R, and capacitor C. The output of the integrator is fed into the hysteresis switch. The hysteresis and output switches function like a Schmitt trigger with the limit points set at the waveform extremes, firing when the triangle wave reaches +1.25 volts and -1.25 volts. The firing sets the hysteresis and the output switches which reverse the square wave fed into the integrator, causing the triangle wave to reverse direction. The result is simultaneous generation of a square wave and triangle wave

of the same frequency with the positive half cycle of the square wave coincident with the negative slope of the triangle wave.

The frequency of oscillation is determined by the magnitude of the capacitor across the integrator and the amplitude of the current into the integrator. The capacitance across the integrator is changed by rotating the frequency Hz selector. The amplitude of the current into the integrator is determined by four parameters which are summed in the VCG circuit: 1) The ± 5 volt square wave fed from the hysteresis switch, 2) the frequency dial voltage, 3) the frequency vernier voltage, and 4) the VCG analog voltage input.

The sine wave is produced by shaping the triangle wave. The triangle wave is fed into a shaping network

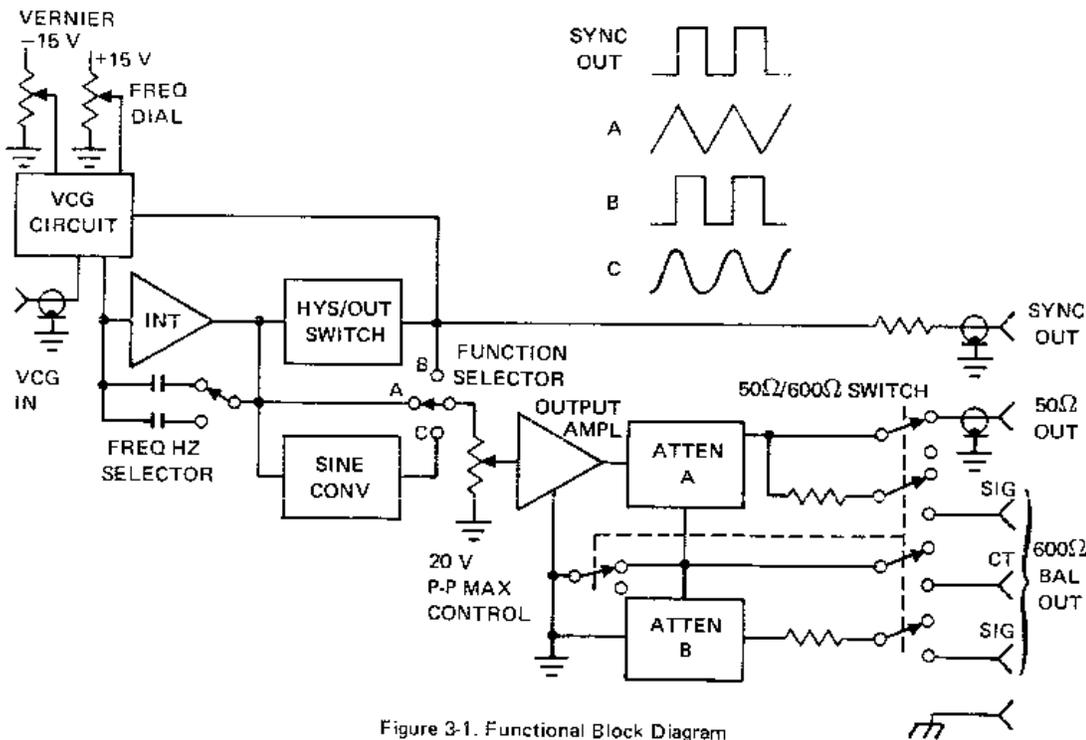


Figure 3-1. Functional Block Diagram

composed of resistors and diodes. As the triangle wave voltage passes through zero, loading of the triangle wave is minimal and thus the slope is maximum. As the triangle wave voltage increases; diodes with current limiting resistors conduct, successively, causing the slope of the output to be less.

Since the diode break points are mathematically computed and fitted to the true sine shape, the resultant waveform is an almost pure sine wave. The circuitry is completely symmetrical about ground, using a complimentary pair of diodes on each break point. The sine wave produced by shaping is considerably less in amplitude than the triangle wave input and is thus amplified to be equal to the triangle wave.

The triangle wave output of the integrator, the sine wave output, and the square wave coupled through a divider are fed to the function selector switch. The

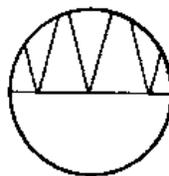
switch is coupled to the attenuator which in turn drives the output power amplifier.

All instrument circuits, except the switch set and the power amplifier output stage, operate with regulated ± 15 volt supplies. The switch set requires regulated ± 6 volts. The power amplifier output stage required unregulated ± 22 volts.

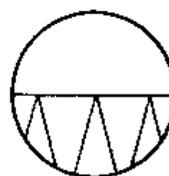
In the Model 131A, a precision step attenuator and an output impedance selector switch is placed between the output amplifier and the output terminals. This circuit allows the output impedance to be selected, either 50Ω single ended or 600Ω balanced. In both cases the properly terminated output signal is 10 V p-p. When the output impedance selector is in the 50Ω position, all positions on the step attenuator provide 50 ohm impedance. When in the 600Ω BAL OUT position, each position on the step attenuator provides 600Ω balanced about signal ground.

Triangle Amplitude

1. Set frequency dial for 2.0 (X1K range) and function selector to ∇ .
2. Connect oscilloscope, with 1A5 plug-in, to red-wire lug on function switch.
3. Adjust R56 on main board for positive peak at +1.25 volts \pm 5 mV (see sketch).
4. Adjust R59 for negative peak at -1.25 volts \pm 5 mV.



Negative Peak



Positive Peak

Output Amplifier ✓

1. Connect oscilloscope to 50 Ω OUT connector with 50-ohm terminator (\square function).
2. Set FREQ HZ selector for X1K (VERNIER full cw) and frequency dial at 2.0.
3. Turn 20 V P-P MAX control fully ccw.
4. Adjust R150 for amplitude symmetry about ground.
5. Set FREQ HZ selector for X1M (2.0 dial setting).
6. Turn 20 V P-P MAX control fully cw.
7. Adjust C64 for best square-wave response without peaking.

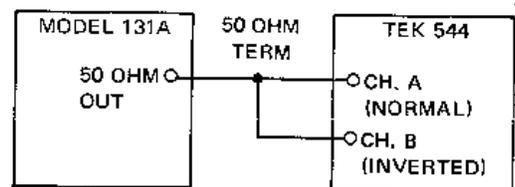
First VCG Null ✓

1. Connect oscilloscope to 50 Ω OUT connector.
2. Set FREQ HZ selector to X1K. Set dial at 1/100 of full scale.
3. Short and open VCG IN to signal ground (outside of BNC connector) while monitoring output frequency variation. Adjust R11 for minimum frequency change.

Time Symmetry ✓

1. Connect unit and oscilloscope, with 1A1 plug-in set for alternate display, as shown in Figure 4-1.
2. Set FREQ HZ selector for X100K with VERNIER in full cw position (\square function).
3. Set frequency dial for 2 kHz on oscilloscope (1/100 dial FS).

4. Adjust R28 for time symmetry at 100:1 frequency ratio.
5. Turn VERNIER fully ccw and adjust R22 for time symmetry at 1000:1.
6. Repeat Steps 4 and 5, as necessary, for optimum symmetry at 100:1 and 1000:1.
7. Check for waveform time symmetry at the .2 and 2 frequency-dial settings.
8. Check to assure FREQ HZ selector is set to X100K position with VERNIER turned fully ccw.
9. Turn frequency dial fully cw.
10. Check for 1000:1 frequency ratio.
11. Adjust R8, if necessary, for slightly greater than 1000:1 ratio.



Trigger: Internal Time Base: 50 microseconds/cm for 1/100 of 200 kHz
 Display: Alternate 500 microseconds/cm for 1/1000 of 200 kHz

Figure 4-1.

Time Symmetry Measurement for Test Setup

Frequency Calibration ✓

1. Connect counter to 50 Ω OUT connector.
2. Set FREQ HZ selector to X10K and VERNIER fully cw.
3. Align 2.0 dial mark with the dial indicator index and alternately switch from X10K to X1K range while adjusting R4 for a balanced error between the two positions.
4. Set FREQ HZ selector to X100K and dial at 2.0.
5. Adjust C16 to obtain 200.0 kHz on counter display.
6. Set FREQ HZ selector to X1M. Adjust C12 to obtain 2.00 MHz on counter display.
7. Dial alignment — No alignment is necessary if the dial is the push-on type. If it has a set screw, consult the factory for CAL procedure.

Sine Distortion, Amplitude, and Balance ✓

1. Set FREQ HZ selector for X1K (VERNIER full cw), function selector to \sim , and frequency dial at 2.0.
2. Connect oscilloscope, with 1A5 plug-in, to orange wire on function switch.
3. Adjust R133 to obtain 2.5 V p-p \pm 25 mV output.
4. Adjust R128 to balance output.
5. Connect the unit, distortion analyzer, and oscilloscope as shown in Figure 4-2.
6. Adjust R126 and R127 for minimum sine distortion (see photo).

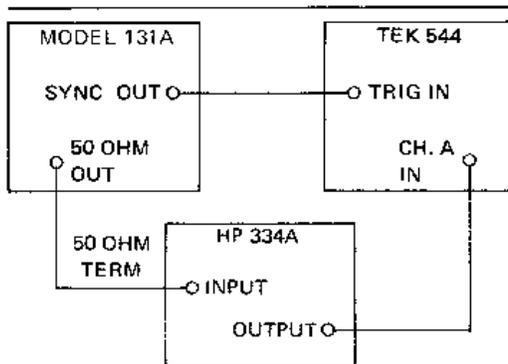
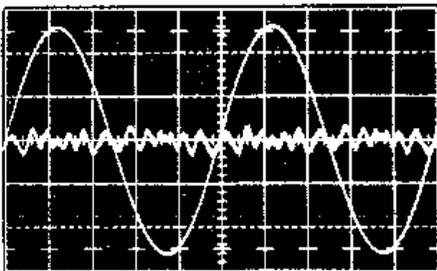


Figure 4-2. Distortion Analysis Test Set-up.



7. Set FREQ HZ selector to X10K.
8. Repeat Step 6 for Steps 1 and 7 to obtain least distortion at both X1K and X10K ranges.
9. Repeat Steps 2, 3, and 4.
10. Connect spectrum analyzer and check sine distortion at 2 MHz.

TROUBLESHOOTING

Basic Techniques

Troubleshooting the Model 131A requires no special technique. Listed below are a few reminders of basic electronics fault isolation.

1. Check control settings carefully. Many times an incorrect control setting, or a knob that has loosened on its shaft, will cause a false indication of a malfunction.
2. Check associated equipment connections. Make sure that all connections are properly connected to the correct connector.
3. Perform the checkout procedure. Many out-of-specification indications can be corrected by performing specific calibration procedures.
4. Visually check the interior of the instrument. Look for such indications as broken wires, charred components, loose leads, etc.

Troubleshooting Chart

Table 4-2 provides a list of possible malfunction symptoms, their probable causes, and the prescribed remedies. Also listed in this table are the test points at which measurements are to be made and the parameter tolerances at these points. To use the troubleshooting chart, locate the symptom listed in Column 1 and follow the corresponding procedures. Localize the fault to a specific stage by checking the parameters given for the major test points. Then check the dc operating voltages at the pins of solid-state devices. Check associated passive elements with a high input impedance ohmmeter (power off) before replacing a suspected semiconductor element.

Troubleshooting Hints

The interactive nature of a closed loop presents a somewhat special problem when approached from a troubleshooting standpoint. The simplest way to reduce problem complexity is to open the loop, thereby removing the interaction. The basic units of the loop can then be tested individually. The following step-by-step procedure describes how this is done. (The generator loop is all contained on the Main Board.) Consult next paragraph for removal of cover and panels.

1. Set instrument controls for 20 V p-p, 2 kHz sine-wave output.
2. Check at coaxial-wire lug of function selector switch for a 2.5 V p-p square wave. If normal, check output amplifier (Q34-Q40).
3. Unsolder and lift the end of R51 (TP7). This is the output of the integrator and input to the hysteresis switch. The generator loop has now been opened.
4. Inject a 2.5 V p-p triangle waveform into the hysteresis switch input lead (TP7).

Table 4-2. TROUBLE SHOOTING CHART

Symptom	Probable Cause	Corrective Procedures
No outputs at 50Ω OUT connector	Blown fuse	Replace F1 a. 1/4A–115 Vac b. 1/8A–230 Vac
	Power Supply	Check TP1/TP2 for +15 V; TP1/TP3 for –15 V; TP1/TP5 for +6 V; TP1/TP6 for –6 V. Troubleshoot associated regulator.
	Output amplifier	Check at wiper (grn/wht wire) of function selector switch for waveform as selected by position of switch. a. If waveform is present, troubleshoot output amplifier. b. If no waveforms are present, refer to Troubleshooting Hints .
No sine wave output	50Ω/600Ω Output Switch	Check to see that output is present at switch. If it is, the switch is defective.
	Sine amplifier	Check for 260 mV p-p sine wave at pin 4 of IC8. a. If present, check IC8 circuit. NOTE: Triangle wave must be present at pin 2 of A1 to obtain sine wave output. b. If <i>not</i> present, check A1 circuit.
No triangle, sine, or square wave	Generator loop	Refer to Troubleshooting Hints .
All waveforms low in amplitude	Power amplifier	a. Check front-panel amplitude control. b. Perform balance adjustment for power amplifier.
	Power supply	Check for proper voltages.
Frequency out of tolerance	Power supply	Check for proper power supply voltages as stated above.
	Maladjustment	Perform calibration procedure.
Sine wave not in spec	Maladjustment	Perform Sine Distortion, Amplitude, and Balance adjustment.
	Sine converter	Check for 260 mV p-p sine wave at pin 4 of IC8. a. If normal, check sine amplifier IC8. b. If abnormal, check A1 circuit.
Time symmetry of waveforms not correct	Maladjustment	Perform Time Symmetry and frequency adjustments.
Output impedance in the 600Ω BAL position is only 300Ω single ended	Half of output attenuator shorted	Isolate all BNC shells from CT or chassis ground. The common mistake is to connect sync out directly to scope without a pulse transformer.

5. Check at the coaxial-wire lug of the function selector switch for a 2.5 V p-p square wave at the injected frequency.
 - a. If present, hysteresis and output switches are okay. Proceed to Step 6.
 - b. If abnormal, check Q6-Q16 stages.
6. Vary frequency dial from ccw to cw while observing TP11 with a scope. Voltage at this point should remain at 0 volts throughout dial rotation. If a voltage variation is observed, check IC1 stage.
7. Vary frequency dial from ccw to cw while observing TP4. Voltage reading should vary from 0 to approximately -6 volts. If voltage does not vary, check IC2 stage and IC1 stage.
8. Vary frequency dial from ccw to cw while observing TP9. Voltage reading should remain at 0 volts. If voltage varies check IC3 stage.
9. Vary frequency dial from ccw to cw while observing TP10. Voltage should vary from 0 volts to approximately +6 volts. If voltage does not vary, check IC2 stage and IC3 stage.
10. Vary frequency dial from ccw to cw while observing TP8. Voltage reading should remain at 0 volts. If voltage varies, check IC4 and IC5 stages.
11. Re-install R51.

REMOVAL OF DUST COVERS AND PANELS

1. To gain access for calibration or maintenance, proceed as follows:
 - a. Remove power cord.
 - b. Loosen the two knurled captive screws on the rear panel.
 - c. Pull off the rear panel.
 - d. Remove the cover.
2. To gain access to any part mounted on bracket assembly behind rear panel, proceed as follows:
 - a. Remove rear panel and dust cover as described in Step 1 above.
 - b. Remove one heat-sink mounting screw.
 - c. Remove bottom transformer mounting-block screw.
 - d. Remove the two screws, lock washers, and hexnuts holding two wafers of FREQ HZ switch to bracket assembly.
 - e. Remove four bracket-assembly retaining screws.
 - f. Carefully pull bracket assembly to rear to obtain working room. Enough slack is available in the wiring for all normal operations.
3. To remove the front panel, proceed as follows:
 - a. Remove rear panel and dust cover as described in Step 1 above.
 - b. Remove all knobs, except frequency dial.

NOTE

Recalibration of the frequency dial is not required if the frequency dial is not removed.

- c. Unsolder BNC connections.
- d. Tag and unsolder frequency-dial potentiometer leads.
- e. Pull light bulb from indicator lens.
- f. Remove four front-panel retaining screws.
- g. Carefully pull off front panel with frequency dial/potentiometer still attached.

REPLACEMENT OF SWITCH WAFERS AND POTENTIOMETERS

1. To replace FREQ HZ switch wafer C or D or the VERNIER potentiometer, proceed as follows:
 - a. Remove rear panel and dust cover as previously described.
 - b. Separate bracket assembly from chassis as previously described.
 - c. Tag and unsolder leads to part being replaced.
 - d. Pull defective part off shaft and repair or replace with recommended replacement part.
2. To replace FREQ HZ switch wafer A or B, proceed as follows:
 - a. Remove rear panel and dust cover as previously described.
 - b. Remove front panel as previously described.
 - c. Tag and unsolder wires to switch wafers A and B.
 - d. Unsolder wafer B PC-tabs from printed circuit board.
 - e. Lift switch shaft slightly to free PC-tabs, rotate switch shaft so wafers clear board parts, and pull shaft end free of rear-mounted wafers C and D.
 - f. Repair or replace defective part.
3. To repair or replace function selector wafers or 20 V P-P MAX potentiometer, proceed as follows:
 - a. Remove rear panel and dust cover as previously described.
 - b. Loosen set screws holding potentiometer and switch knobs to inner and outer shafts and remove knobs.
 - c. Tag and unsolder wires to defective part.
 - d. Unsolder potentiometer PC-tabs, lift shaft slightly to free tabs, rotate switch shaft so wafers clear board parts, and pull switch/

- potentiometer assembly out of front panel hole.
- e. Repair or replace defective part.

REPLACEMENT OF SINE CONVERTER

1. Remove rear panel and dust cover as previously described.
2. Unsolder the five pins of sine converter A1 from top of the printed circuit board, using a solder syringe.
3. Lift assembly from bottom of the board; a thin pencil-type soldering iron can be used, if necessary, to apply temporary heat during removal.

SECTION 5

DATA PACKAGE

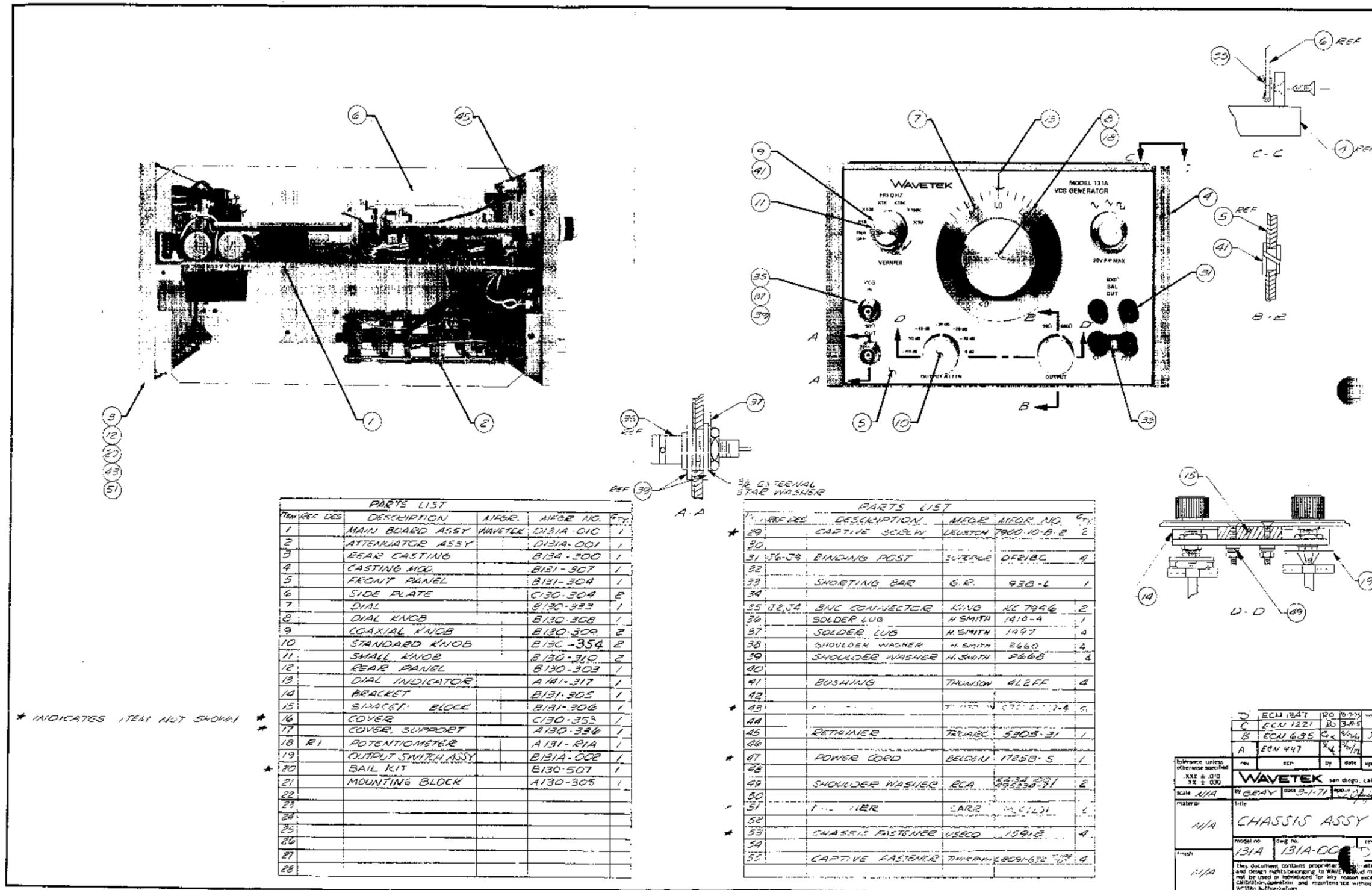
INTRODUCTION

In this section are the schematics and assembly drawings for the Model 131A. Parts lists and list of manufacturers are included for ordering spare or replacement parts. **IMPORTANT** — When ordering a part from Wavetek, give all pertinent data — Part number, circuit reference number, value of the component and/or function performed.

LIST OF MANUFACTURERS

- American Radionics . . . American Radionics, Inc.
Danbury, Connecticut
- Amp Amphenol Connector Division
Broadview, Illinois
- ARCO Arco Electronics
Great Neck, L.I., New York
- Boots Boots-Townsend Aircraft
Santa Ana, California
- Corn Corning Glass Works
Bradford, Pennsylvania
- CRL Centralab
Division of Globe-Union
Milwaukee, Wisconsin
- CTS Chicago Telephone Systems
Los Angeles, California
- Electro Electro Cube, Inc.
Willow Grove, Pennsylvania
- Erie Erie Technological Products Inc.
Erie, Pennsylvania
- Fair Fairchild Semiconductor Corporation
Palo Alto, California

- IMB IMB Electronics Products
Santa Fe Springs, California
- IRC IRC Inc.
Philadelphia, Pennsylvania
- Kings Kings Electronics Co., Inc.
Tickahoe, New York
- Littelfuse Littelfuse Inc.
Des Plaines, Illinois
- Motorola Motorola Semiconducts Products
Phoenix, Arizona
- RCA RCA Semiconductor Division
Somerville, New Jersey
- Richey Richey Electronics
Nashville, Tennessee
- Semtech Semtech Corporation
Newbury Park, California
- HHSmith Herman H. Smith, Inc.
Brooklyn, New York
- Sprague Sprague Electric Company
North Adams, Massachusetts
- Stack Stackpole Carbon Company
St. Marys, Pennsylvania
- Switchcraft Switchcraft, Inc.
Chicago, Illinois
- TI Texas Instruments, Inc.
Dallas, Texas
- USECO USECO Inc.
Mt. Vernon, New York
- Wakefield Wakefield Engineering, Inc.
Wakefield, Massachusetts
- Wavetek Wavetek
San Diego, California



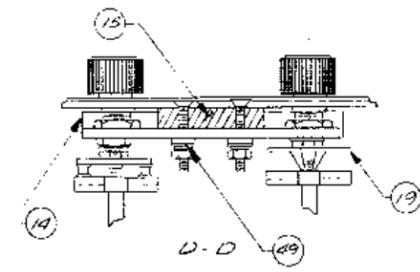
PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR.	PART NO.	QTY
1		MAIN BOARD ASSY	WAVETEK	D131A-010	1
2		ATTENUATOR ASSY		D131A-001	1
3		BEAR CASTING		B134-200	1
4		CASTING MISC		B121-307	1
5		FRONT PANEL		B121-304	1
6		SIDE PLATE		C130-304	2
7		DIAL		B130-323	1
8		DIAL KNOB		B130-308	1
9		COAXIAL KNOB		B130-309	2
10		STANDARD KNOB		B130-354	2
11		SMALL KNOB		B130-310	2
12		REAR PANEL		B130-303	1
13		DIAL INDICATOR		A141-317	1
14		BRACKET		B131-305	1
15		SUPPORT BLOCK		B131-306	1
16		COVER		C130-353	1
17		COVER SUPPORT		A130-336	1
18	R1	POTENTIOMETER		A131-R1A	1
19		OUTPUT SWITCH ASSY		B121A-002	1
20		BAIL KIT		B130-507	1
21		MOUNTING BLOCK		A130-305	1
22					
23					
24					
25					
26					
27					
28					

* INDICATES ITEM NOT SHOWN *

PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR.	PART NO.	QTY
29		CAPTIVE SCREW	LEWIS	TR00-10-B-E	2
30					
31	J6-J9	BINDING POST	SUPER	OFF/B-C	4
32					
33		SHORTING BAR	G.R.	93B-L	1
34					
35	T2, J4	BNC CONNECTOR	KING	KC7946	2
36		SOLDER LUG	H SMITH	1410-4	1
37		SOLDER LUG	H SMITH	1497	4
38		SHOULDER WASHER	H SMITH	2660	4
39		SHOULDER WASHER	H SMITH	P666	4
40					
41		BUSHING	THOMSON	4L2FF	4
42					
43					
44					
45		RETAINER	TRIAEC	5305-31	1
46					
47		POWER CORD	BEIDAN	1725B-S	1
48					
49		SHOULDER WASHER	ECA	53230-31	2
50					
51		WASHER	LAGZ	13-2143L	1
52					
53		CHASSIS FASTENER	USBCO	15912	4
54					
55		CAPTIVE FASTENER	THOMSON	4L2FF	4



rev	ECN 1247	100	10-2-75	vol. 1
	ECN 1221	85	3-8-75	
	ECN 695	5	10-1-75	
	ECN 447	4	3/4/72	

WAVETEK san diego, calif.

scale N/A

material N/A

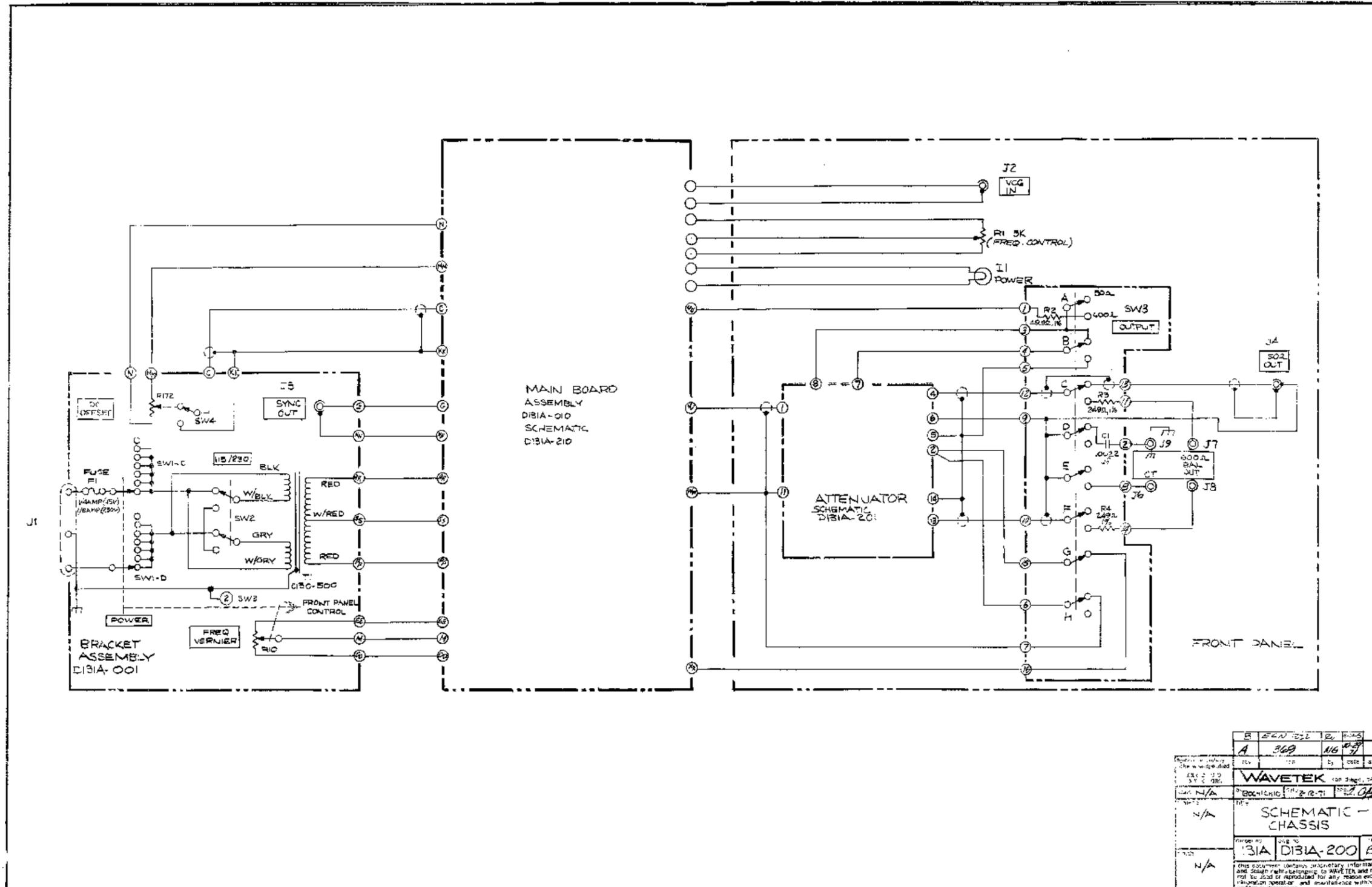
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model no 131A

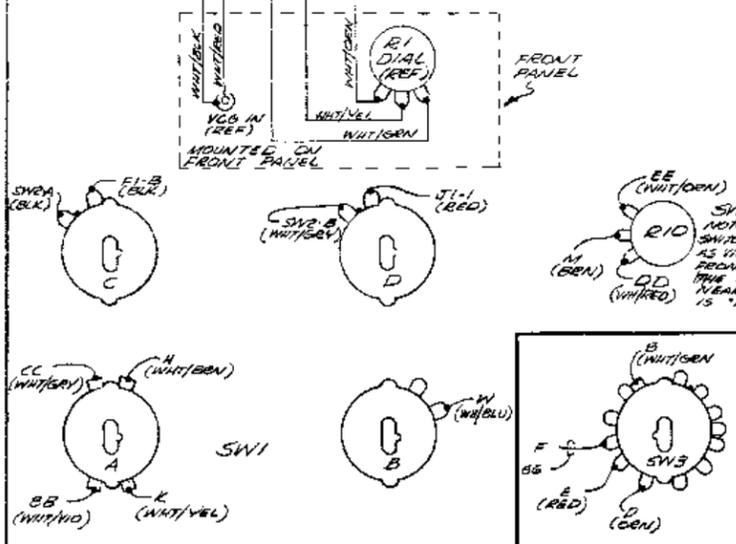
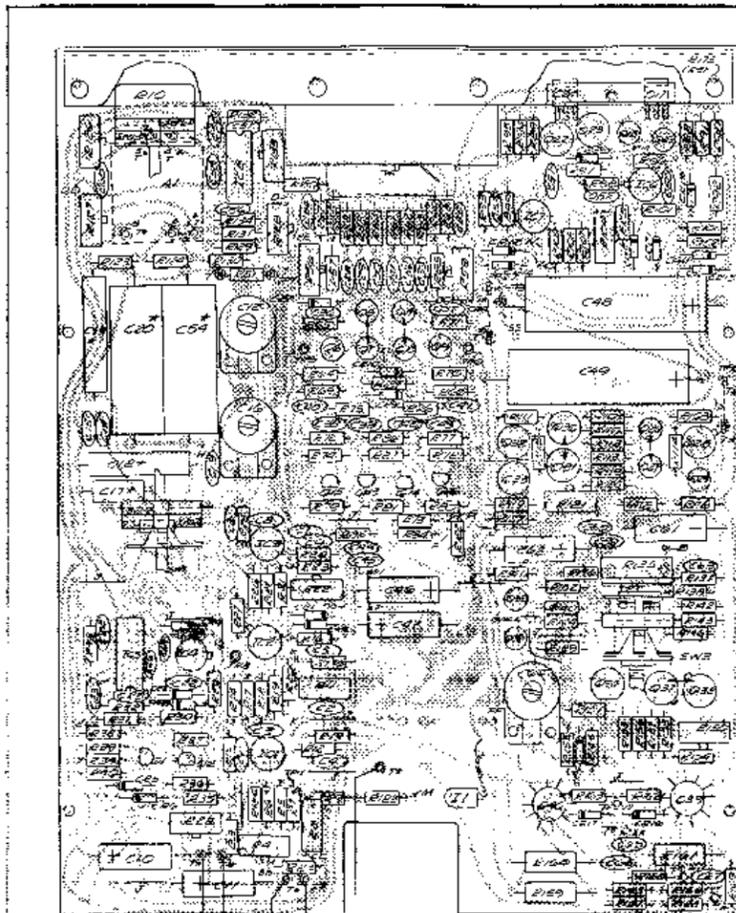
diag no 131A-00

high N/A

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REV	DATE	BY	CHKD
A	3/69	UG	0-27
WAVETEK (analog)			
DATE	BY	CHKD	BY
N/A			
SCHEMATIC - CHASSIS			
DATE	BY	CHKD	BY
N/A			
<small>This document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason except for repair, operation, and maintenance without written permission.</small>			



REF DES	DESCRIPTION	MFR	MFR NO	QTY
1	C19	SLURF MFR 200.5 SUP	DM2-2603	1
2	C28, C35	5K60F	8003	1
3	C29, C32	151J	151J	2
4	C30, C31	500PF	3013	2
5	C18	500PF	561J	2
6	C15, C22	1% 100K	971R	1
7	C23, C25	22PF	DD-100	2
8	C24, C26	33PF	DD-220	2
9	C27, C28	33PF	DD-470	2
10	C33, C42	33PF	DD-151	2
11	C37, C66	150PF	DD-381	1
12	C63	330PF	DD-381	1
13	C40, C41	680PF	DD-661	2
14	C5, C8, C50	220PF	DD-221	4
15	C1, C6, C22, C52	50V, .005F	CK502	4
16	C45, C66	50V, .01F	CK-103	2
17	C34, C39, C44, C45, C57, C60	20V, .1UF	UK20-104	16
18	C17	POLY 100V 1K .01F	WAVTEK 130-501-B	1
19	C18	1K		1
20	C19	1K		1
21	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100	VARIOUS		

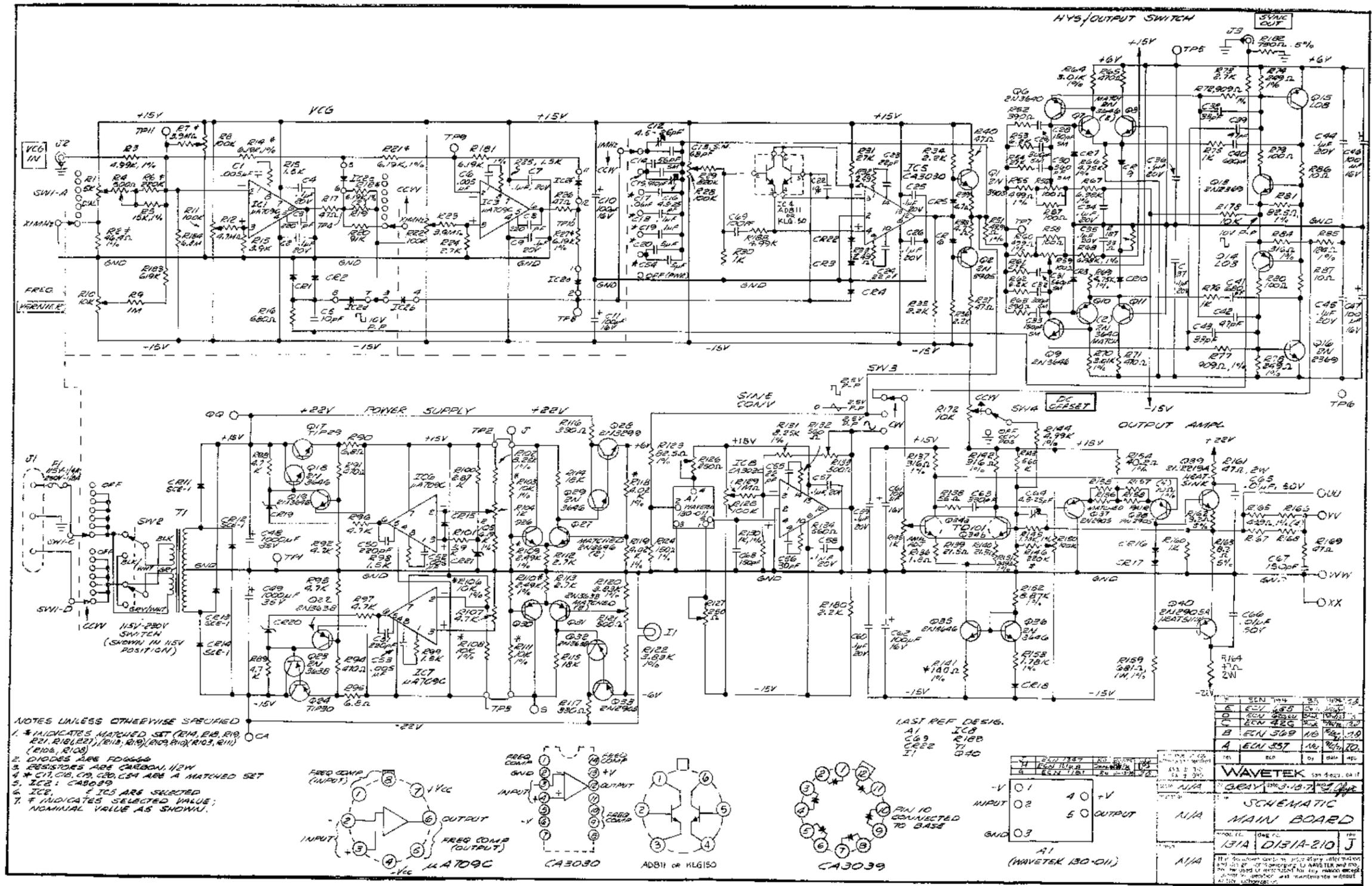
REF DES	DESCRIPTION	MFR	MFR NO	QTY
57	IC1, IC3	LINEAR IC (-13)	FAIRCHILD UA109C	1
58	IC5	LINEAR IC (-15)	RCA CA3020	1
59	IC4	DUAL TRM	ANALOG AD 811	1
60	IC2	LINEAR (-18)	RCA CA3039	1
61	IC6, IC7	LINEAR (-14)	FAIRCHILD UA109C	2
62	IC8	LINEAR (-16)	RCA CA3030	1
63				
64				
65	R58, R59	POTENTIOMETER 100K	CRL BA103-501	2
66	R24, R27	250K		2
67	R4	500K		3
68	R181, R183	500K		2
69	R155	1K	CTS	1
70	R104	1K	CRL BA103-501	1
71	R3, R122, R28, R38, R50	100K		6
72	R10	10K	CTS 150-21A	1
73				
74				
75	R162, R163	CARBON, 5% 5K, 2A STALE	RC20CFR2J	2
76	R134	CARBON, 10% 5K, 1/2W, 2A STALE	RC20CFR2J	1
77	R38, R39	4.7K	4710	2
78	R90, R95	6.8K	6800	2
79	R36, R37	100K	1000	2
80	R138	500K	5000	1
81	R17, R20, R21, R40, R49	47K	4700	5
82	R57, R58, R79, R80	100K	1000	4
83	R116, R117	10% 300K	300K	2
84	R52, R63	5% 500K	500K	2
85	R25, R71, R91, R94	10% 470K	470K	4
86	R182, R184	500K	500K	2
87	R16	680K	680K	1
88	R30, R76, R10, R160	1K	1000	4
89	R15, R23, R26, R39	1.5K	1500	4
90	R30, R36	2.2K	2200	4
91	R39, R78, R12, R18	2.7K	2700	4
92	R13, R101	3.9K	3900	2
93	R20, R29, R32, R33, R34, R37, R101	4.7K	4700	7
94	R53, R62	5% 6.2K	6200	2
95	R178	10% 10K	10000	1
96	R14, R18	18K	18000	2
97	R31, R54	27K	27000	3
98	R20	47K	47000	1
99	R1, R46	220K	220000	2
100				
101	R143	500K	500000	1
102	R29	500K	500000	1
103	R129	1M	1000000	1
104				
105	R74, R23	390K	390000	2
106	R12	4.7K	47000	1
107	R184	6.8K	68000	1
108	R162	5% 750K	750000	1
109	R187	39K	39000	1
110	R16, R164	2% 10% 27K	RC20CFR2J	2
111	R159	METAL FILM, 1/4W, 1% 68K	IRC REC EN100	1
112	R32, R33	10% 1/2W 1% 240K	EDWARDS RUS50	2
113	R108	10% 1/2W 1% 4.99K	RUS50	1
114				
115				
116	R109, R110	METAL FILM, 1/4W, 1% 500K	EDWARDS RUS50	2
117	R110, R119	400K		2
118	R103, R106, R105, R111	10K (1.2)		4
119	R14, R118, R19, R21, R81	6.8K (-3)		6
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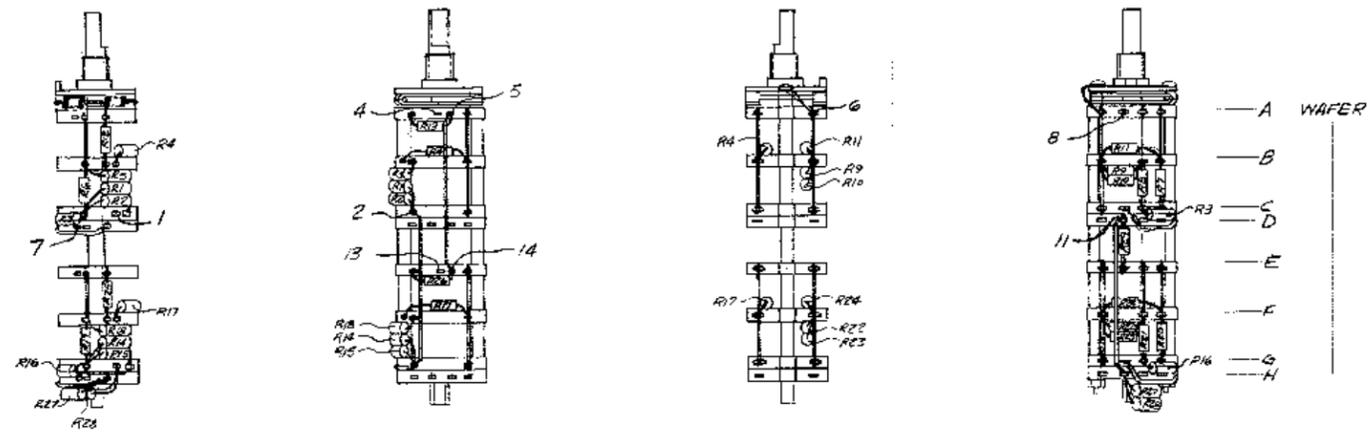
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124	R155-R158	METAL FILM, 1/4W, 1% 100K	EDWARDS RUS50	4
125	R159, R160	2.15K		2
126	R2	46.4K		1
127	R1, R165, R166	49.9K		3
128	R154	40.2K		1
129	R81, R163	62.5K		2
130	R25	180K		1
131	R124	150K		1
132	R74, R178	249K		3
133	R84, R157, R162	316K		3
134	R53, R60	499K		2
135	R72, R77	709K		2
136	R130	1K		1
137	R143, R153	1.78K		2
138	R100	2.27K		1
139	R4, R70	3.01K		2
140	R132, R133	3.9K		2
141	R141	4.3K		1
142	R26, R29	4.75K		2
143	R3, R44	4.99K		2
144				
145	R105	6.18K		1
146	R27, R38	6.98K		2
147	R102, R151	8.25K		2
148	R152	8.27K		1
149	R5	15K		1
150	R153	6.8K		1
151	R3	1M		1
152				
153				
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- 1. * INDICATES MATCHED SET
- 2. T# TERMINAL CASESIDE
- 3. T# TERMINAL MFR SIDE
- 4. # SELECTED VALUE
- 5. ↔ MATCHED PAIRS

REV 1.00	DATE 10/10/70	BY J. J. JONES
REV 1.01	DATE 11/10/70	BY J. J. JONES
REV 1.02	DATE 12/10/70	BY J. J. JONES
REV 1.03	DATE 01/10/71	BY J. J. JONES
REV 1.04	DATE 02/10/71	BY J. J. JONES
REV 1.05	DATE 03/10/71	BY J. J. JONES
REV 1.06	DATE 04/10/71	BY J. J. JONES
REV 1.07	DATE 05/10/71	BY J. J. JONES
REV 1.08	DATE 06/10/71	BY J. J. JONES
REV 1.09	DATE 07/10/71	BY J. J. JONES
REV 1.10	DATE 08/10/71	BY J. J. JONES
REV 1.11	DATE 09/10/71	BY J. J. JONES
REV 1.12	DATE 10/10/71	BY J. J. JONES
REV 1.13	DATE 11/10/71	BY J. J. JONES
REV 1.14	DATE 12/10/71	BY J. J. JONES
REV 1.15	DATE 01/10/72	BY J. J. JONES
REV 1.16	DATE 02/10/72	BY J. J. JONES
REV 1.17	DATE 03/10/72	BY J. J. JONES
REV 1.18	DATE 04/10/72	BY J. J. JONES
REV 1.19	DATE 05/10/72	BY J. J. JONES
REV 1.20	DATE 06/10/72	BY J. J. JONES
REV 1.21	DATE 07/10/72	BY J. J. JONES
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REV 1.24	DATE 10/10/72	BY J. J. JONES
REV 1.25	DATE 11/10/72	BY J. J. JONES
REV 1.26	DATE 12/10/72	BY J. J. JONES
REV 1.27	DATE 01/10/73	BY J. J. JONES
REV 1.28	DATE 02/10/73	BY J. J. JONES
REV 1.29	DATE 03/10/73	BY J. J. JONES
REV 1.30	DATE 04/10/73	BY J. J. JONES
REV 1.31	DATE 05/10/73	BY J. J. JONES
REV 1.32	DATE 06/10/73	BY J. J. JONES
REV 1.33	DATE 07/10/73	BY J. J. JONES
REV 1.34	DATE 08/10/73	BY J. J. JONES
REV 1.35	DATE 09/10/73	BY J. J. JONES
REV 1.36	DATE 10/10/73	BY J. J. JONES
REV 1.37	DATE 11/10/73	BY J. J. JONES
REV 1.38	DATE 12/10/73	BY J. J. JONES
REV 1.39	DATE 01/10/74	BY J. J. JONES
REV 1.40	DATE 02/10/74	BY J. J. JONES
REV 1.41	DATE 03/10/74	BY J. J. JONES
REV 1.42	DATE 04/10/74	BY J. J. JONES
REV 1.43	DATE 05/10/74	BY J. J. JONES
REV 1.44	DATE 06/10/74	BY J. J. JONES
REV 1.45	DATE 07/10/74	BY J. J. JONES
REV 1.46	DATE 08/10/74	BY J. J. JONES
REV 1.47	DATE 09/10/74	BY J. J. JONES
REV 1.48	DATE 10/10/74	BY J. J. JONES
REV 1.49	DATE 11/10/74	BY J. J. JONES
REV 1.50	DATE 12/10/74	BY J. J. JONES

WAVETEK
 GEAR 3-7
 ASSY
 MAIN BOARD
 131A D131A-D10 K

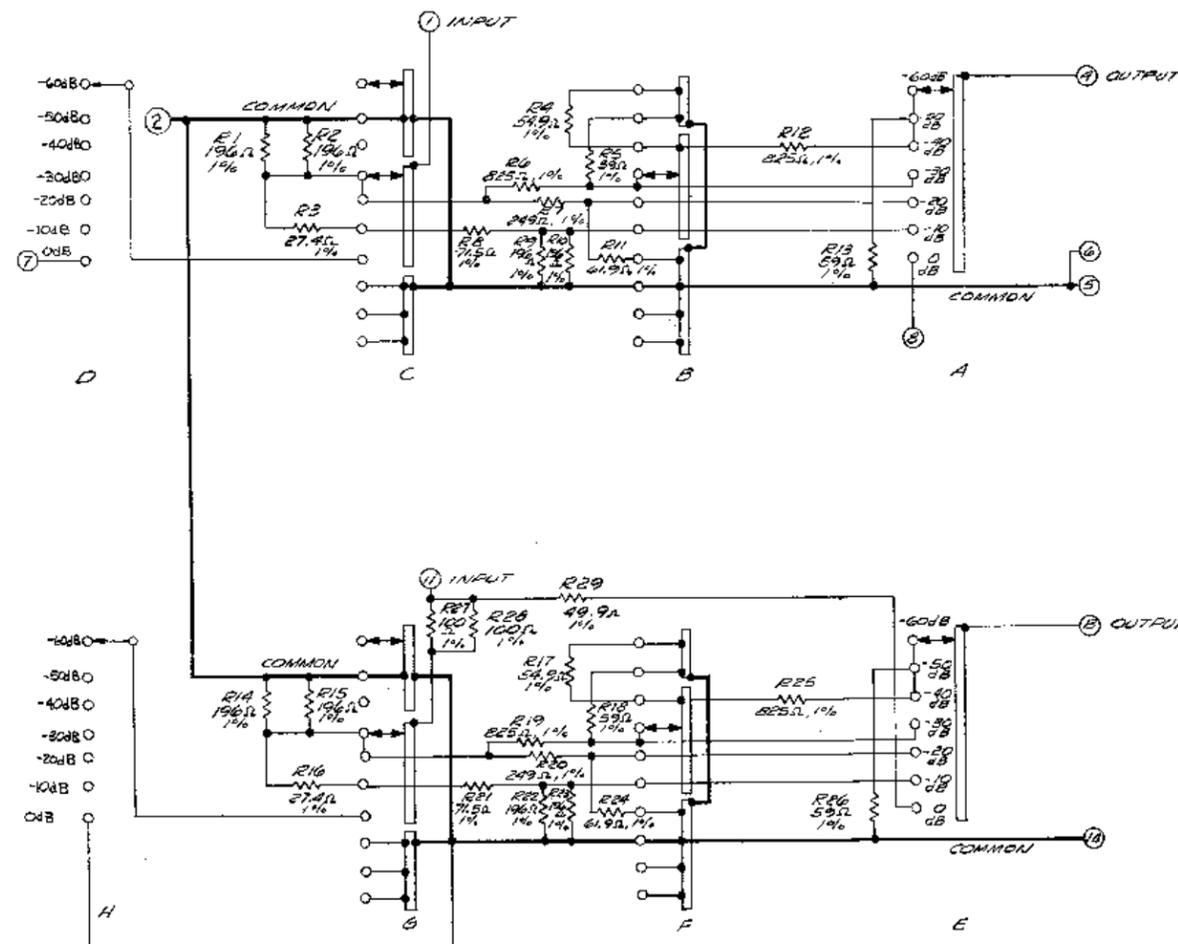




NOTES UNLESS OTHERWISE SPECIFIED
 1 NUMBERS INDICATE WIRE TERMINATION POINTS SEE DISA-200

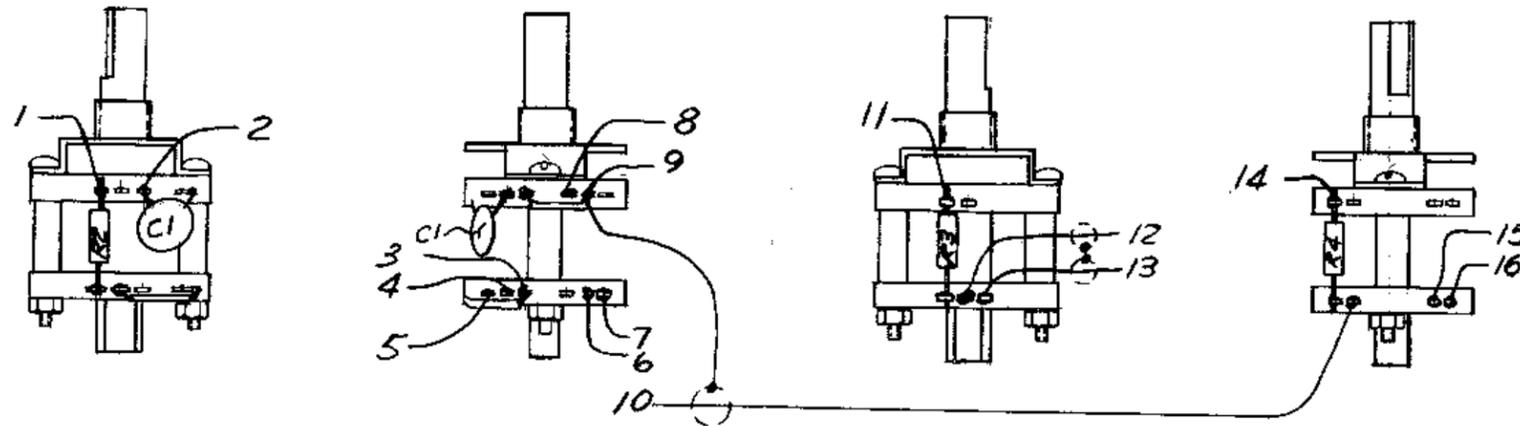
PARTS LIST					
ITEM	REF. DES.	DESCRIPTION	MFR	MFR NO	QTY
1	R3, R16	RES. METAL FILM, 1/4W, 1%, 274Ω	GRUWING	RN1600	2
2	R29		49.9Ω		1
3	R4, R17		54.9Ω		2
4	R5, R18 R15, R26		59Ω		4
5	R11, R24		61.9Ω		2
6	R8, R21		71.5Ω		2
7	R27, R28		100Ω		2
8	R1, R2, R9 R10, R14 R15, R22 R23		196Ω		8
9	R7, R20		249Ω		2
10	R6, R12 R19, R25		825Ω		4
11					
12					
13					
14					
15		DETENT AND WAFER ASSY	WAVETEK	131A-SW1	1
16					
17					
18					
19					
20					

tolerance unless otherwise specified	rev	scr	by	date	app.
.xxx ± .030 .xx ± .030					
WAVETEK	san diego, calif.				
made FULL	by BOCHKIN on 2-15-71				
material N/A	title ASSY - ATTENUATOR SW				
finish N/A	model no.	dwg no.	rev		
	131A	D131A-001			
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NOTES: UNLESS OTHERWISE SPECIFIED
 1. CIRCLED NUMBERS, I.E. (1) ETC, INDICATE WIRING INTERCONNECTIONS
 2. SEE SCHEMATIC 131A-200

tolerance unless otherwise specified	rev	sch	by	date	app.
XXX ± 0.10 XX ± 0.05					
scale N/A					
material N/A					
finish N/A					
WAVETEK san diego, calif by GRAY 2-12-71 J.C.P. title SCHEMATIC ATTENUATOR model no. 131A des. no. D131A-201 rev.					
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PARTS LIST					
ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY
1	R2	RES METALFILM 1/4W, 1% 499Ω	CORNING	RNG0D	1
2	R3, R4	249Ω			2
3					
4					
5	C1	CAPACITOR, DISC 1000V, .0022μf	CRL	DD-222	1
6					
7		DETENT	WAVETEK	134-304-7	1
8		WAFER	CTS	T109	2
9		STANDOFF (1/2" SPACER)	CTS		2

NOTES:
1 FOR SCHEMATIC SEE D131A-200

TOLERANCE UNLESS OTHERWISE SPEC	REV	EDR	BY	DATE	APP
XXX .000	WAVETEK SAN DIEGO CALIF.				
XX .001	DATE 2-16-71 BY G. J. G.				
ANGLES .030	TITLE ASS'Y OUTPUT SWITCH				
SCALE FULL	MODEL NO. 131A DWG NO. B131A-002				
MATERIAL N/A	THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION OPERATION AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.				
FINISH N/A					

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