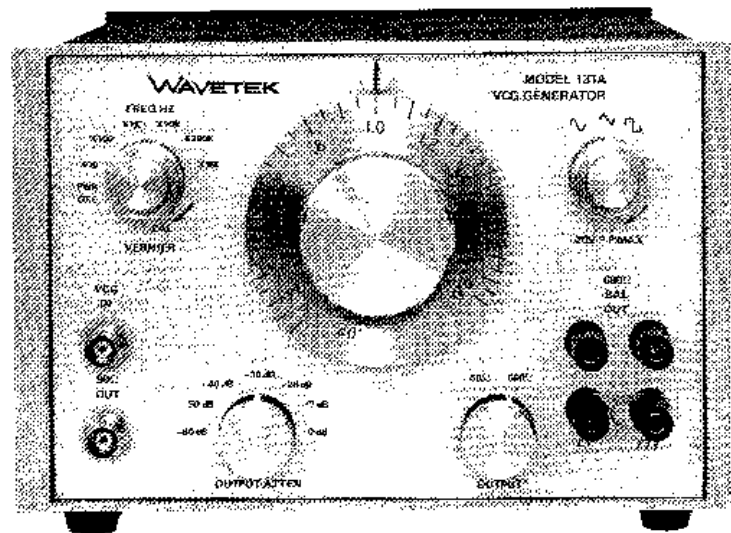


INSTRUCTION MANUAL

# 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.

## WARRANTY

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.

# CONTENTS

| Section |                                                           | Page No. |
|---------|-----------------------------------------------------------|----------|
| 1       | SPECIFICATIONS                                            |          |
|         | Versatility . . . . .                                     | 1        |
|         | Horizontal Precision . . . . .                            | 1        |
|         | Vertical Precision . . . . .                              | 1        |
|         | Purity . . . . .                                          | 2        |
|         | Environmental . . . . .                                   | 2        |
|         | Mechanical . . . . .                                      | 2        |
| 2       | OPERATION                                                 |          |
|         | Inspection . . . . .                                      | 3        |
|         | Operating Controls . . . . .                              | 4        |
|         | Operation . . . . .                                       | 5        |
| 3       | CIRCUIT DESCRIPTION                                       |          |
|         | General Description . . . . .                             | 8        |
| 4       | MAINTENANCE                                               |          |
|         | Introduction . . . . .                                    | 10       |
|         | Recommended Test Equipment . . . . .                      | 10       |
|         | Checkout and Calibration . . . . .                        | 10       |
|         | Troubleshooting . . . . .                                 | 12       |
|         | Removal of Dust Covers and Panels . . . . .               | 14       |
|         | Replacement of Switch Wafers and Potentiometers . . . . . | 14       |
|         | Replacement of Sine Converter . . . . .                   | 15       |
| 5       | DATA PACKAGE                                              |          |
|         | Introduction . . . . .                                    | 16       |
|         | List of Manufacturers . . . . .                           | 16       |

## 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 $\Omega$ OUT      | 0.2 Hz to 2 MHz  |
| 600 $\Omega$ BAL OUT | 0.2 Hz to 20 kHz |
| 600 $\Omega$ 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 $\Omega$  output impedance, 20 V p-p into open circuit and 10 V p-p into 50 $\Omega$  load from 50 $\Omega$  source impedance, 600 $\Omega$  output impedance balanced with center tap; 20 V p-p into open circuit and 10 V p-p into 600 $\Omega$  balanced load from 600 $\Omega$  balanced source impedance. Short circuit current is  $\pm 100$  milliamperes.

#### NOTE

*When 600 $\Omega$  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 $\Omega$  output impedance.

#### DC Offset

$\pm 5$  V offset ( $\pm 2.5$  V offset into 50 $\Omega$  load or 600 $\Omega$  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/ $\mu$ 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

$\pm 0.25$  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 600 $\Omega$  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 50 $\Omega$  OUT connector with a 50-ohm terminator and set the 50/600 $\Omega$  selector to 50 $\Omega$ .
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 600 $\Omega$  balanced output connectors to a differential input oscilloscope (Tektronix 1A5 plug-in or equivalent) as shown in Figure 2-1.
14. Set 50/600 $\Omega$  selector to 600 $\Omega$ .
15. Repeat steps 5 through 10.

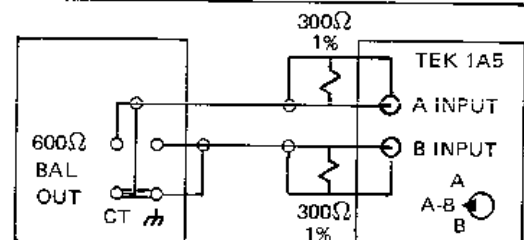


Figure 2-1. Test Set-up for 600 $\Omega$  BAL

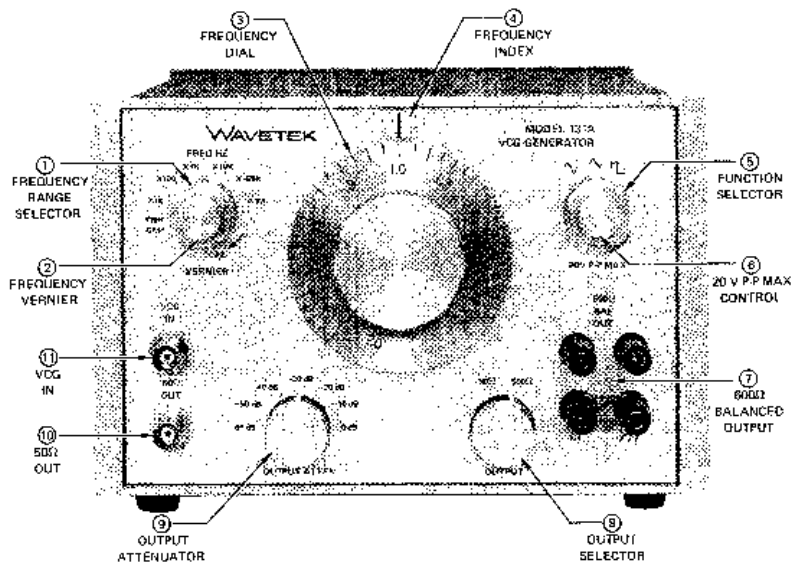


Figure 2-2. Operating Controls

## 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  $\wedge$ , 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 ATTN (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.

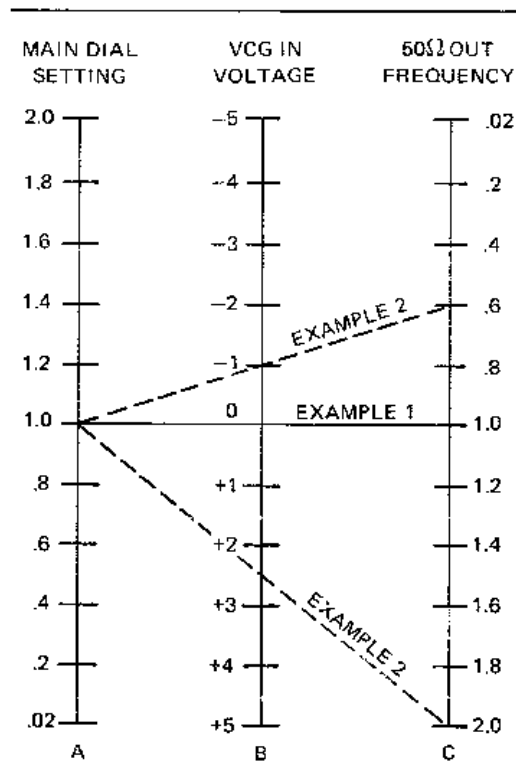


Figure 2-3 - VCG Voltage-to-Frequency Nomograph

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

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  $600\Omega$  balanced output.

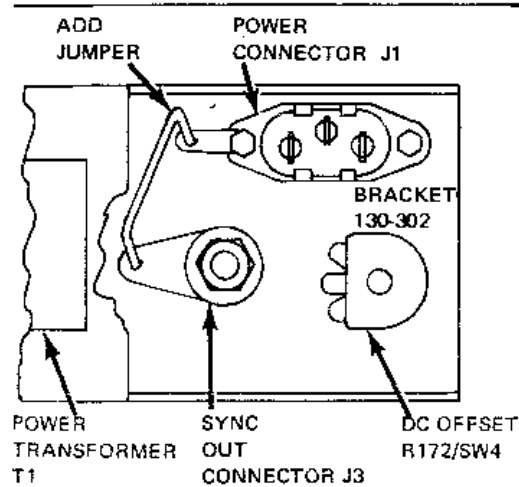


Figure 2-4. Common Ground Connection Diagram

#### Connecting Sync Out to an Oscilloscope

When in the  $600\Omega$  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 ( $300\Omega$ ) will be lost. The amplitude will remain the same, but the result is a  $300\Omega$  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.

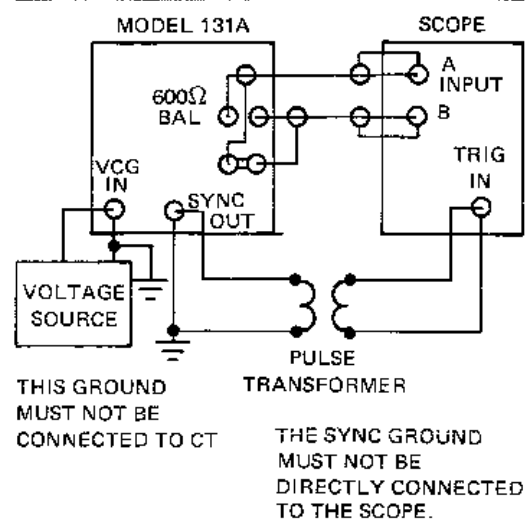


Figure 2-5.  $600\Omega$  Sync Out Connections

#### Connecting Chassis Ground to Center Tap

If it is desirable to balance the  $600\Omega$  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  $\pm 5$  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

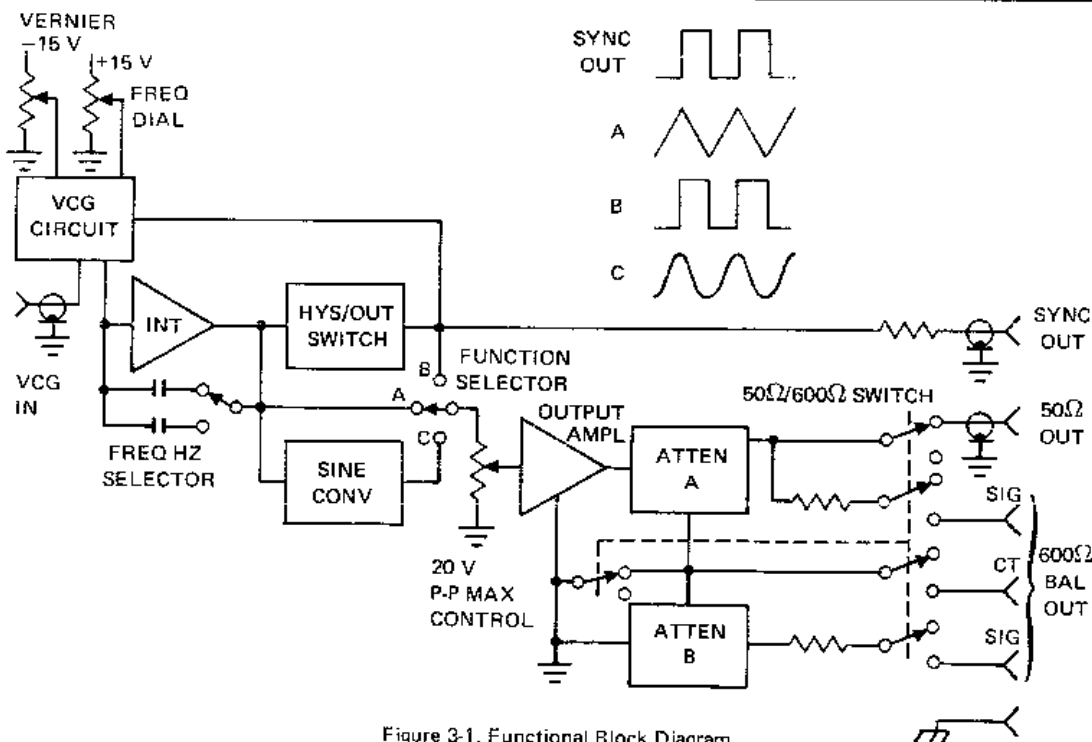


Figure 3-1. Functional Block Diagram

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  $\pm 15$  volt supplies. The switch set requires regulated  $\pm 6$  volts. The power amplifier output stage required unregulated  $\pm 22$  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  $50\Omega$  single ended or  $600\Omega$  balanced. In both cases the properly terminated output signal is 10 V p-p. When the output impedance selector is in the  $50\Omega$  position, all positions on the step attenuator provide 50 ohm impedance. When in the  $600\Omega$  BAL OUT position, each position on the step attenuator provides  $600\Omega$  balanced about signal ground.

# SECTION 4

## MAINTENANCE

### INTRODUCTION

This section provides instructions for testing, calibrating, troubleshooting, and repairing the Model 131 and 131A. The additional features of the 131A require additional calibration. The instructions are concise and for the experienced electronics technician or field engineer. Wavetek maintains a factory-repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to facilitate the turnaround time. Test point and adjustment locations are illustrated in Section 5.

### RECOMMENDED TEST EQUIPMENT

Table 4-1 contains a list of recommended test equipment. Any test equipment having equivalent accuracies may be substituted for those listed.

Table 4-1. TEST EQUIPMENT

| Name                      | Required Characteristics     | Recommended Manufacturer | Model |
|---------------------------|------------------------------|--------------------------|-------|
| Oscilloscope              | To 30 MHz                    | Tektronix                | 544   |
| Plug-In                   | Dual Channel                 | Tektronix                | 1A1   |
| Plug-In                   | Peak mV measuring capability | Tektronix                | 1A5   |
| Distortion Analyzer       | To 600 kHz                   | Hewlett-Packard          | 334A  |
| Spectrum Analyzer Display | To 50 MHz                    | Hewlett-Packard          | 141S  |
| IF Section                |                              | Hewlett-Packard          | 8552A |
| RF Section                |                              | Hewlett-Packard          | 8553L |

10

Voltmeter      Millivolt dc      .01% Accuracy  
measurement

Counter      To 10 MHz      0.1% of reading accuracy

### CHECKOUT AND CALIBRATION

The following paragraphs provide complete sequential calibration procedures for the Model 131A. Instrument checkout procedures are indicated by a checkmark (✓) following the procedure title. A quick checkout of the instrument can be performed by comparing the indicated parameters with the tolerances given in the Specifications of Section 1.

#### NOTE

*The entire calibration procedure must be read first to determine initial control settings and test equipment connections before attempting checkout.*

#### Preliminary Procedures

1. Set FREQ HZ selector to the X1K position.
2. Set 50Ω/600Ω selector to 50Ω.
3. Set OUTPUT ATTENUATOR to 0 dB.
4. Allow one-half hour for warmup.

#### Power Supply Regulation

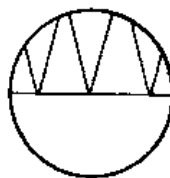
1. Connect voltmeter between TP1 (common) and TP2 (+) on Main Board. Adjust R104 for +15 Vdc ±100 mV.
2. Connect voltmeter between TP1 (common) and TP3 (-). Since the negative supply is referenced to the +15-volt supply, the voltmeter should indicate -15 Vdc ±100 mV.

#### Square Wave Amplitude Symmetry

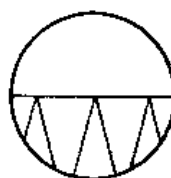
1. Set function selector to .
2. Connect oscilloscope, with 1A5 plug-in, to coaxial-wire lug on function switch.
3. Using a comparator, set the positive peak to the center of the scope. Switch the comparator to the negative peak and adjust R121 so that the negative peak equals the positive peak.

**Triangle Amplitude**

1. Set frequency dial for 2.0 (X1K range) and function selector to  $\Delta$ .
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 $\Omega$  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 $\Omega$  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.

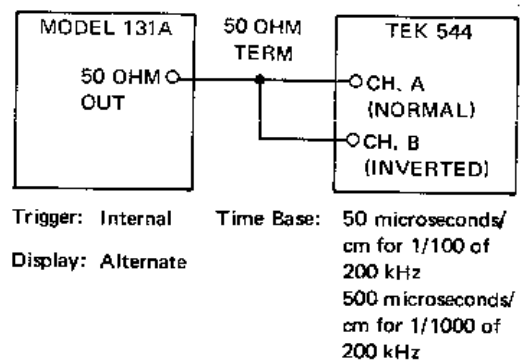


Figure 4-1.

Time Symmetry Measurement for Test Setup

**Frequency Calibration ✓**

1. Connect counter to 50 $\Omega$  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).

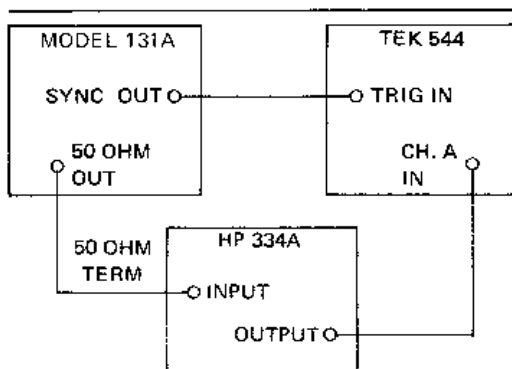
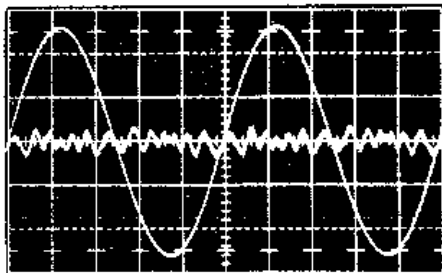


Figure 4-2. Distortion Analysis Test Set-up.



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 50 $\Omega$ OUT connector                                             | Blown fuse                              | Replace F1<br>a. 1/4A–115 Vac<br>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.<br>a. If waveform is present, troubleshoot output amplifier.<br>b. If no waveforms are present, refer to <b>Troubleshooting Hints</b> . |
|                                                                                     | 50 $\Omega$ /600 $\Omega$ Output Switch | Check to see that output is present at switch. If it is, the switch is defective.                                                                                                                                                                 |
| No sine wave output                                                                 | Sine amplifier                          | Check for 260 mV p-p sine wave at pin 4 of IC8.<br>a. If present, check IC8 circuit.<br><b>NOTE:</b> Triangle wave must be present at pin 2 of A1 to obtain sine wave output.<br>b. If <i>not</i> present, check A1 circuit.                      |
| No triangle, sine, or square wave                                                   | Generator loop                          | Refer to <b>Troubleshooting Hints</b> .                                                                                                                                                                                                           |
| All waveforms low in amplitude                                                      | Power amplifier                         | a. Check front-panel amplitude control.<br>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 <b>Sine Distortion</b> , <b>Amplitude</b> , and <b>Balance</b> adjustment.                                                                                                                                                                |
|                                                                                     | Sine converter                          | Check for 260 mV p-p sine wave at pin 4 of IC8.<br>a. If normal, check sine amplifier IC8.<br>b. If abnormal, check A1 circuit.                                                                                                                   |
| Time symmetry of waveforms not correct                                              | Maladjustment                           | Perform <b>Time Symmetry</b> and frequency adjustments.                                                                                                                                                                                           |
| Output impedance in the 600 $\Omega$ BAL position is only 300 $\Omega$ 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

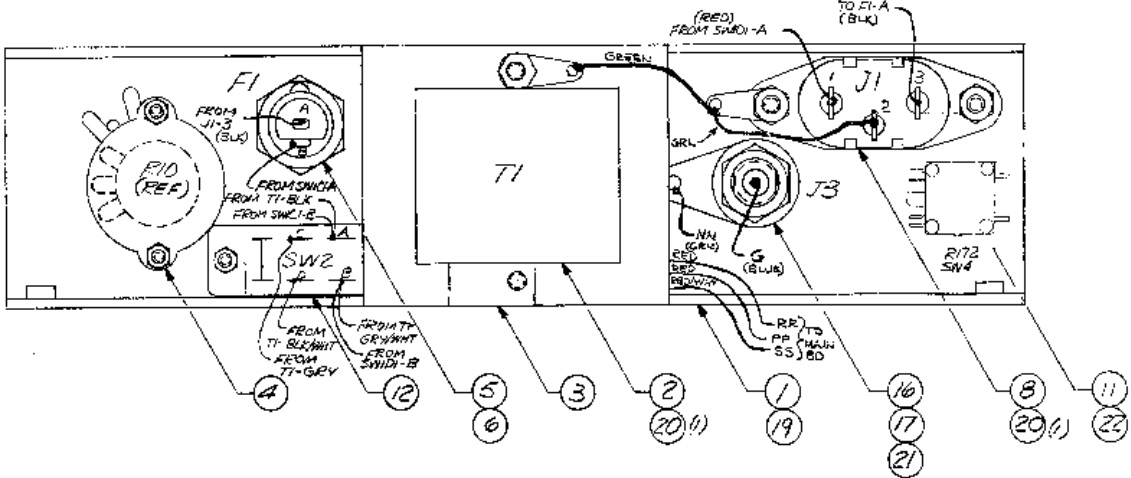
### INTRODUCTION

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

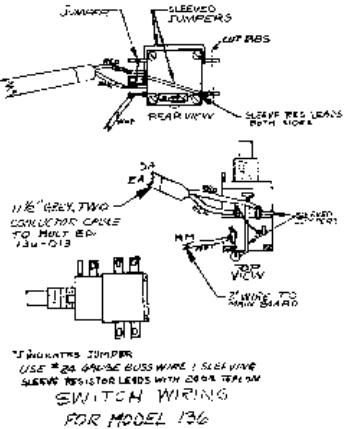
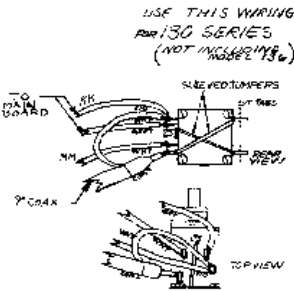


| PARTS LIST |          |                              |             |              |     |
|------------|----------|------------------------------|-------------|--------------|-----|
| ITEM       | REF DES  | DESCRIPTION                  | MFR         | MFR NO       | QTY |
| 1          |          | BRACKET                      | WAVETEK     | B130-302     | 1   |
| 2          | T1       | TRANSFORMER                  |             | 6130-500     | 1   |
| 3          |          | TRANSFORMER BRACKET          |             | A130-306     | 1   |
| 4          |          | STANDOFF (MODEL 130 ONLY)    | H.H. SMITH  | 2342         | 2   |
| 5          | F1       | FUSE (1/8AMP, 250V)          | LITTELFUSE  | 318-250      | 1   |
| 6          |          | FUSE HOLDER                  |             | 342012       | 1   |
| 7          |          | FUSE 1/8AMP, 250V            |             | MDL 118      | 1   |
| 8          | J1       | POWER RECEPTACLE             | SWITCHBOARD | LACS-4       | 1   |
| 9          | R76      | RESISTOR 1/4W 10% CARBON 25K | STANLEY     | AC206F242K   | 1   |
| 10         |          |                              |             |              |     |
| 11         | R17, SWA | DC OFFSET SWITCH 10K/5W      | A-B         | 70160320030A | 1   |
| 12         | SW2      | 115-230V SWITCH              | SWITCHBOARD | 46256L2      | 1   |
| 13         |          |                              |             |              |     |
| 14         |          | MICA INSULATOR               | WVTK        | A740-307     | 1   |
| 15         |          | HEATSINK                     |             | A130-311     | 1   |
| 16         | J3       | BNC CONNECTOR                | KING        | KCT946       | 1   |
| 17         |          | SHOULDER WASHER              | SMITH       | 266B         | 2   |
| 18         |          |                              |             |              |     |
| 19         |          | FASTENERS #6-32              | SOUTHD      | 74-11-100-13 | 4   |
| 20         |          | SOLDER LUG                   | H.H. SMITH  | 1914-4       | 2   |
| 21         |          | SOLDER LUG                   |             | 1497         | 1   |
| 22         |          | KNOS                         | ELNA        | 020-222      | 1   |
| 23         |          |                              |             |              |     |
| 24         |          |                              |             |              |     |
| 25         |          |                              |             |              |     |

FOR 115V MODEL

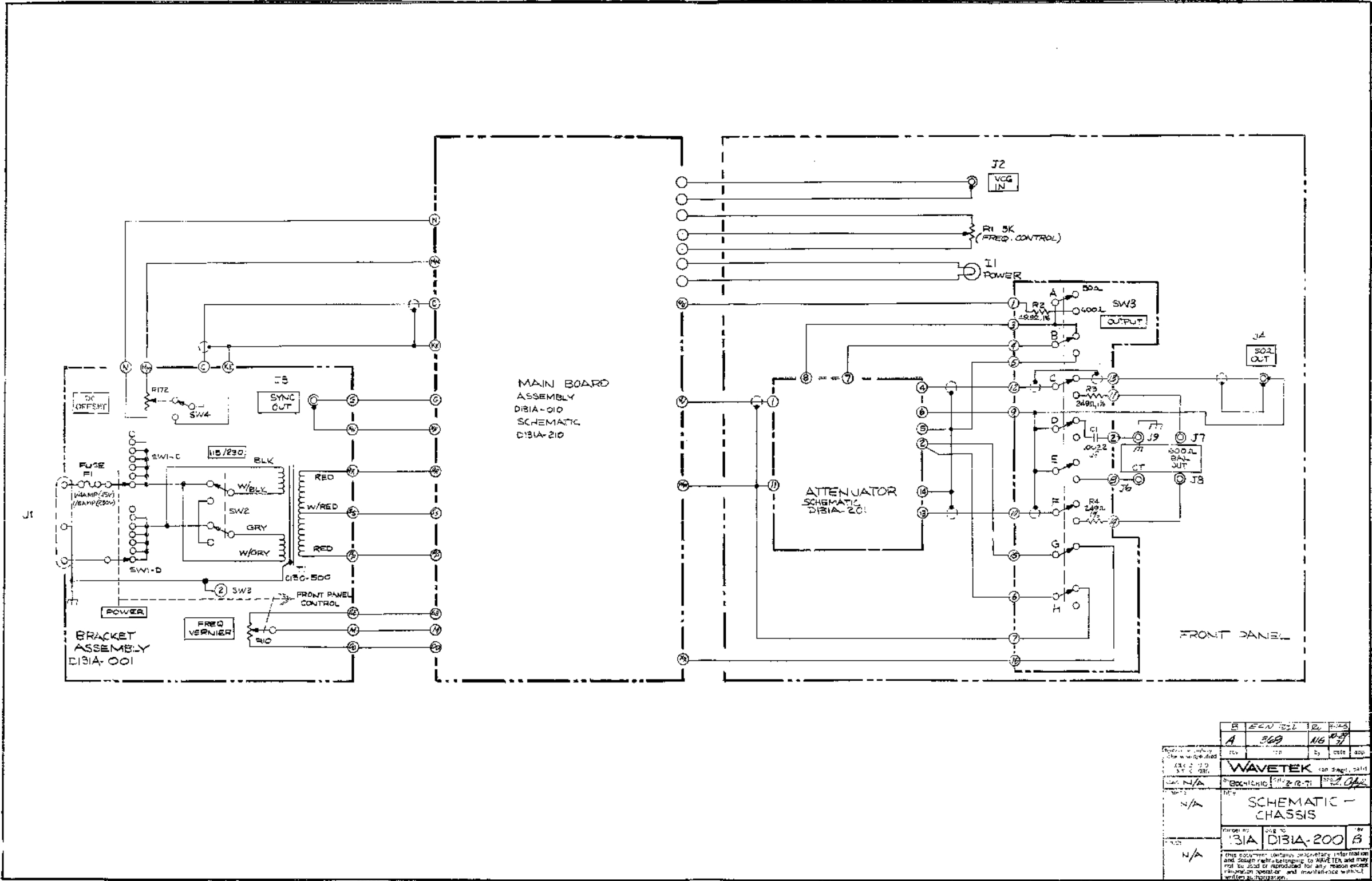
FOR 230V MODEL

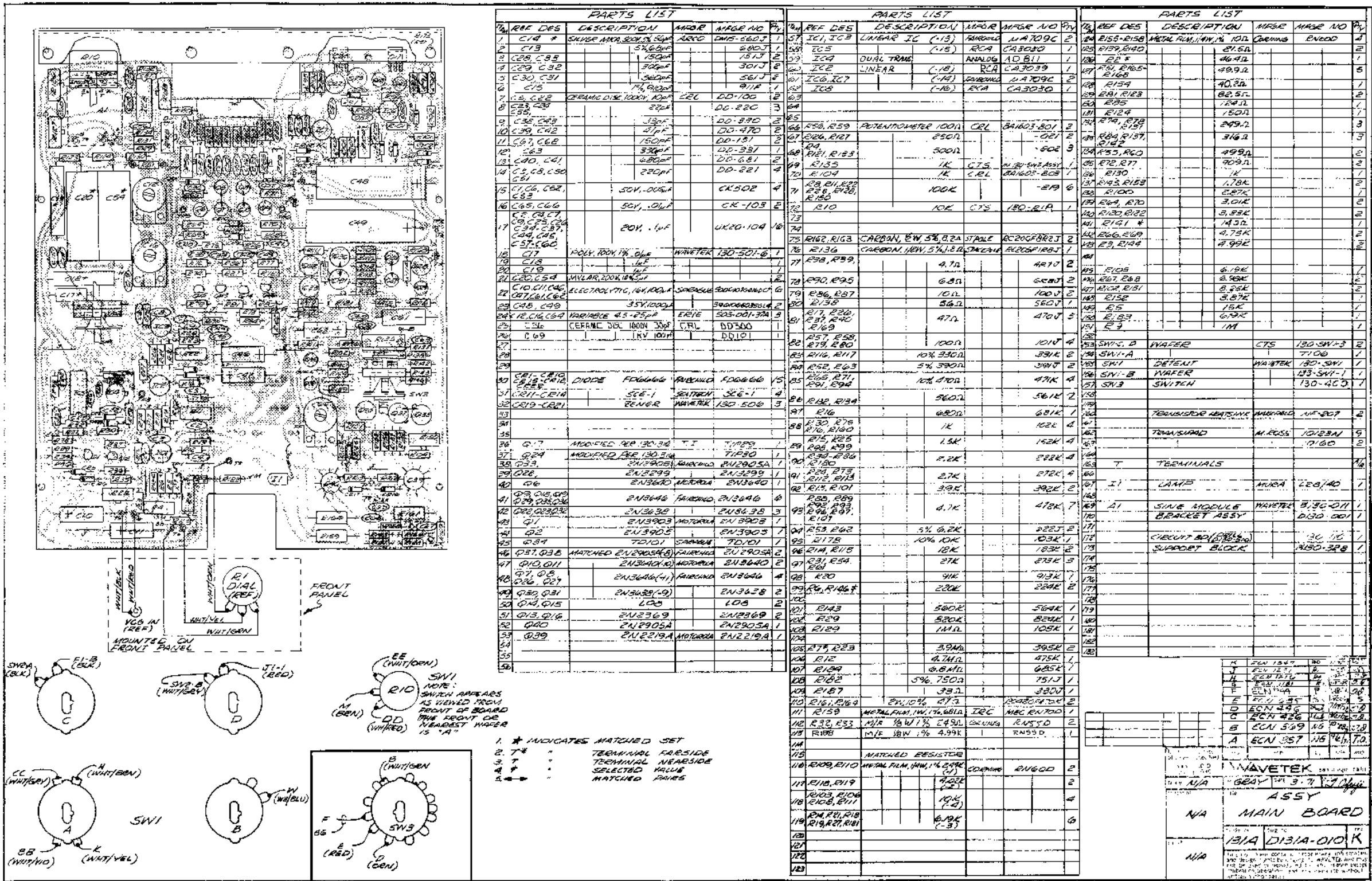
MODEL 136 ONLY



|                                                                                                                                                                                                                      |               |       |               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------|---------------|
| H                                                                                                                                                                                                                    | ECN 1306      | 26    | 1/25/77       |
| G                                                                                                                                                                                                                    | ECN 1242      | 20    | 1/25/77       |
| F                                                                                                                                                                                                                    | ECN 878       | 04    | 1/25/77       |
| E                                                                                                                                                                                                                    | ECN 501       | 11    | 1/25/77       |
| D                                                                                                                                                                                                                    | J1 WAS P-03-G | 2     | 1/15/77       |
| C                                                                                                                                                                                                                    | ECN 341       | 115   | 1/15/77       |
| B                                                                                                                                                                                                                    | COP 29        | 115   | 1/15/77       |
| A                                                                                                                                                                                                                    | ECN 283       | 8     | 1/15/77       |
| rev                                                                                                                                                                                                                  | des           | by    | shp           |
| Tolerance in mils unless otherwise specified                                                                                                                                                                         |               |       |               |
| XXX = 0.012 ± .003                                                                                                                                                                                                   |               |       |               |
| scale                                                                                                                                                                                                                | N/A           | DATE  | 7-21-69       |
| material                                                                                                                                                                                                             | N/A           | title | ASSY, BRACKET |
| made in                                                                                                                                                                                                              | USA           | date  | 120-136       |
| inch                                                                                                                                                                                                                 | N/A           | date  | 120-001 H     |
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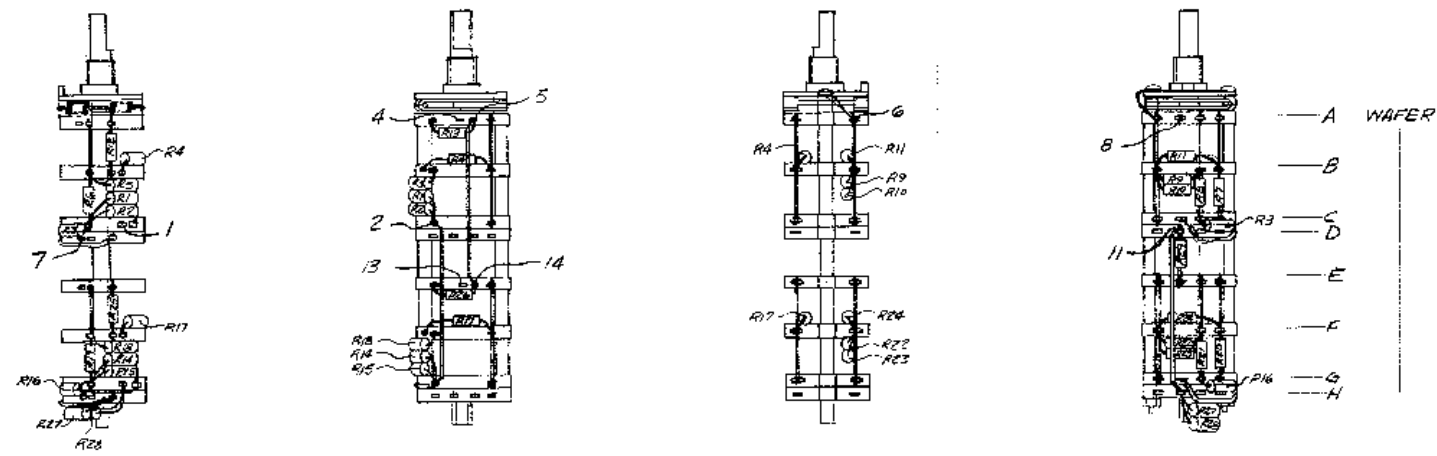
| PARTS LIST |                              |                         |     |             |
|------------|------------------------------|-------------------------|-----|-------------|
| REF        | DES                          | DESCRIPTION             | MFR | MFR NO      |
| 1          | C14                          | 5K60PF                  | DAI | 2603        |
| 2          | C28, C35                     | 150PF                   | DAI | 1513        |
| 3          | C29, C32                     | 50PF                    | DAI | 3013        |
| 4          | C30, C31                     | 50PF                    | DAI | 5613        |
| 5          | C15                          | 150PF                   | DAI | 9713        |
| 6          | C22                          | CERAMIC DISC 100V, 10PF | DAI | DD-100      |
| 7          | C23, C24                     | 22PF                    | DAI | DD-220      |
| 8          | C25, C26                     | 33PF                    | DAI | DD-330      |
| 9          | C27, C28                     | 21PF                    | DAI | DD-470      |
| 10         | C33, C34                     | 150PF                   | DAI | DD-151      |
| 11         | C36, C37                     | 33PF                    | DAI | DD-331      |
| 12         | C38                          | 33PF                    | DAI | DD-331      |
| 13         | C40, C41                     | 68PF                    | DAI | DD-681      |
| 14         | C3, C8, C50                  | 220PF                   | DAI | DD-221      |
| 15         | C1, C6, C22, C23             | 50V, .005F              | DAI | CK502       |
| 16         | C45, C46                     | 50V, .01F               | DAI | CK-103      |
| 17         | C39, C42, C43, C44, C47, C48 | 20V, .1F                | DAI | UK20-104    |
| 18         | C17                          | POLY. 100V, 1K, 0.6     | DAI | 130-501-6   |
| 19         | C18                          | 1K                      | DAI | 1           |
| 20         | C19                          | 1K                      | DAI | 1           |
| 21         | C10, C11, C40                | ELECTROLYTIC, 16V, 100F | DAI | 3000K500PF  |
| 22         | C49, C50                     | 35V, 1000F              | DAI | 3000K500PF  |
| 23         | C45, C46                     | VARIABLE 45-25PF        | DAI | 503-001-374 |
| 24         | C51                          | CERAMIC DISC 100V, 33PF | DAI | DD-330      |
| 25         | C52                          | 1KV 100F                | DAI | DD101       |
| 26         | C53                          | 1KV 100F                | DAI | DD101       |
| 27         | C54                          | 1KV 100F                | DAI | DD101       |
| 28         | C55                          | 1KV 100F                | DAI | DD101       |
| 29         | C56                          | 1KV 100F                | DAI | DD101       |
| 30         | C57                          | 1KV 100F                | DAI | DD101       |
| 31         | C58                          | 1KV 100F                | DAI | DD101       |
| 32         | C59                          | 1KV 100F                | DAI | DD101       |
| 33         | C60                          | 1KV 100F                | DAI | DD101       |
| 34         | C61                          | 1KV 100F                | DAI | DD101       |
| 35         | C62                          | 1KV 100F                | DAI | DD101       |
| 36         | C63                          | 1KV 100F                | DAI | DD101       |
| 37         | C64                          | 1KV 100F                | DAI | DD101       |
| 38         | C65                          | 1KV 100F                | DAI | DD101       |
| 39         | C66                          | 1KV 100F                | DAI | DD101       |
| 40         | C67                          | 1KV 100F                | DAI | DD101       |
| 41         | C68                          | 1KV 100F                | DAI | DD101       |
| 42         | C69                          | 1KV 100F                | DAI | DD101       |
| 43         | C70                          | 1KV 100F                | DAI | DD101       |
| 44         | C71                          | 1KV 100F                | DAI | DD101       |
| 45         | C72                          | 1KV 100F                | DAI | DD101       |
| 46         | C73                          | 1KV 100F                | DAI | DD101       |
| 47         | C74                          | 1KV 100F                | DAI | DD101       |
| 48         | C75                          | 1KV 100F                | DAI | DD101       |
| 49         | C76                          | 1KV 100F                | DAI | DD101       |
| 50         | C77                          | 1KV 100F                | DAI | DD101       |
| 51         | C78                          | 1KV 100F                | DAI | DD101       |
| 52         | C79                          | 1KV 100F                | DAI | DD101       |
| 53         | C80                          | 1KV 100F                | DAI | DD101       |
| 54         | C81                          | 1KV 100F                | DAI | DD101       |
| 55         | C82                          | 1KV 100F                | DAI | DD101       |
| 56         | C83                          | 1KV 100F                | DAI | DD101       |
| 57         | C84                          | 1KV 100F                | DAI | DD101       |
| 58         | C85                          | 1KV 100F                | DAI | DD101       |
| 59         | C86                          | 1KV 100F                | DAI | DD101       |
| 60         | C87                          | 1KV 100F                | DAI | DD101       |
| 61         | C88                          | 1KV 100F                | DAI | DD101       |
| 62         | C89                          | 1KV 100F                | DAI | DD101       |
| 63         | C90                          | 1KV 100F                | DAI | DD101       |
| 64         | C91                          | 1KV 100F                | DAI | DD101       |
| 65         | C92                          | 1KV 100F                | DAI | DD101       |
| 66         | C93                          | 1KV 100F                | DAI | DD101       |
| 67         | C94                          | 1KV 100F                | DAI | DD101       |
| 68         | C95                          | 1KV 100F                | DAI | DD101       |
| 69         | C96                          | 1KV 100F                | DAI | DD101       |
| 70         | C97                          | 1KV 100F                | DAI | DD101       |
| 71         | C98                          | 1KV 100F                | DAI | DD101       |
| 72         | C99                          | 1KV 100F                | DAI | DD101       |
| 73         | C100                         | 1KV 100F                | DAI | DD101       |
| 74         | C101                         | 1KV 100F                | DAI | DD101       |
| 75         | C102                         | 1KV 100F                | DAI | DD101       |
| 76         | C103                         | 1KV 100F                | DAI | DD101       |
| 77         | C104                         | 1KV 100F                | DAI | DD101       |
| 78         | C105                         | 1KV 100F                | DAI | DD101       |
| 79         | C106                         | 1KV 100F                | DAI | DD101       |
| 80         | C107                         | 1KV 100F                | DAI | DD101       |
| 81         | C108                         | 1KV 100F                | DAI | DD101       |
| 82         | C109                         | 1KV 100F                | DAI | DD101       |
| 83         | C110                         | 1KV 100F                | DAI | DD101       |
| 84         | C111                         | 1KV 100F                | DAI | DD101       |
| 85         | C112                         | 1KV 100F                | DAI | DD101       |
| 86         | C113                         | 1KV 100F                | DAI | DD101       |
| 87         | C114                         | 1KV 100F                | DAI | DD101       |
| 88         | C115                         | 1KV 100F                | DAI | DD101       |
| 89         | C116                         | 1KV 100F                | DAI | DD101       |
| 90         | C117                         | 1KV 100F                | DAI | DD101       |
| 91         | C118                         | 1KV 100F                | DAI | DD101       |
| 92         | C119                         | 1KV 100F                | DAI | DD101       |
| 93         | C120                         | 1KV 100F                | DAI | DD101       |
| 94         | C121                         | 1KV 100F                | DAI | DD101       |
| 95         | C122                         | 1KV 100F                | DAI | DD101       |
| 96         | C123                         | 1KV 100F                | DAI | DD101       |
| 97         | C124                         | 1KV 100F                | DAI | DD101       |
| 98         | C125                         | 1KV 100F                | DAI | DD101       |
| 99         | C126                         | 1KV 100F                | DAI | DD101       |
| 100        | C127                         | 1KV 100F                | DAI | DD101       |

| PARTS LIST |          |                    |     |           |
|------------|----------|--------------------|-----|-----------|
| REF        | DES      | DESCRIPTION        | MFR | MFR NO    |
| 57         | IC1, IC3 | LINEAR IC (-13)    | DAI | NA709C    |
| 58         | IC5      | LINEAR IC (-15)    | DAI | CA3030    |
| 59         | IC6      | DUAL TRM           | DAI | AD 511    |
| 60         | IC7      | LINEAR IC (-18)    | DAI | CA3039    |
| 61         | IC8      | LINEAR IC (-19)    | DAI | CA709C    |
| 62         | IC9      | LINEAR IC (-16)    | DAI | CA3030    |
| 63         | IC10     | POTENTIOMETER 100K | DAI | BA403-801 |
| 64         | IC11     | POTENTIOMETER 100K | DAI | BA403-801 |
| 65         | IC12     | POTENTIOMETER 100K | DAI | BA403-801 |
| 66         | IC13     | POTENTIOMETER 100K | DAI | BA403-801 |
| 67         | IC14     | POTENTIOMETER 100K | DAI | BA403-801 |
| 68         | IC15     | POTENTIOMETER 100K | DAI | BA403-801 |
| 69         | IC16     | POTENTIOMETER 100K | DAI | BA403-801 |
| 70         | IC17     | POTENTIOMETER 100K | DAI | BA403-801 |
| 71         | IC18     | POTENTIOMETER 100K | DAI | BA403-801 |
| 72         | IC19     | POTENTIOMETER 100K | DAI | BA403-801 |
| 73         | IC20     | POTENTIOMETER 100K | DAI | BA403-801 |
| 74         | IC21     | POTENTIOMETER 100K | DAI | BA403-801 |
| 75         | IC22     | POTENTIOMETER 100K | DAI | BA403-801 |
| 76         | IC23     | POTENTIOMETER 100K | DAI | BA403-801 |
| 77         | IC24     | POTENTIOMETER 100K | DAI | BA403-801 |
| 78         | IC25     | POTENTIOMETER 100K | DAI | BA403-801 |
| 79         | IC26     | POTENTIOMETER 100K | DAI | BA403-801 |
| 80         | IC27     | POTENTIOMETER 100K | DAI | BA403-801 |
| 81         | IC28     | POTENTIOMETER 100K | DAI | BA403-801 |
| 82         | IC29     | POTENTIOMETER 100K | DAI | BA403-801 |
| 83         | IC30     | POTENTIOMETER 100K | DAI | BA403-801 |
| 84         | IC31     | POTENTIOMETER 100K | DAI | BA403-801 |
| 85         | IC32     | POTENTIOMETER 100K | DAI | BA403-801 |
| 86         | IC33     | POTENTIOMETER 100K | DAI | BA403-801 |
| 87         | IC34     | POTENTIOMETER 100K | DAI | BA403-801 |
| 88         | IC35     | POTENTIOMETER 100K | DAI | BA403-801 |
| 89         | IC36     | POTENTIOMETER 100K | DAI | BA403-801 |
| 90         | IC37     | POTENTIOMETER 100K | DAI | BA403-801 |
| 91         | IC38     | POTENTIOMETER 100K | DAI | BA403-801 |
| 92         | IC39     | POTENTIOMETER 100K | DAI | BA403-801 |
| 93         | IC40     | POTENTIOMETER 100K | DAI | BA403-801 |
| 94         | IC41     | POTENTIOMETER 100K | DAI | BA403-801 |
| 95         | IC42     | POTENTIOMETER 100K | DAI | BA403-801 |
| 96         | IC43     | POTENTIOMETER 100K | DAI | BA403-801 |
| 97         | IC44     | POTENTIOMETER 100K | DAI | BA403-801 |
| 98         | IC45     | POTENTIOMETER 100K | DAI | BA403-801 |
| 99         | IC46     | POTENTIOMETER 100K | DAI | BA403-801 |
| 100        | IC47     | POTENTIOMETER 100K | DAI | BA403-801 |

| PARTS LIST |       |                    |     |           |
|------------|-------|--------------------|-----|-----------|
| REF        | DES   | DESCRIPTION        | MFR | MFR NO    |
| 101        | IC48  | POTENTIOMETER 100K | DAI | BA403-801 |
| 102        | IC49  | POTENTIOMETER 100K | DAI | BA403-801 |
| 103        | IC50  | POTENTIOMETER 100K | DAI | BA403-801 |
| 104        | IC51  | POTENTIOMETER 100K | DAI | BA403-801 |
| 105        | IC52  | POTENTIOMETER 100K | DAI | BA403-801 |
| 106        | IC53  | POTENTIOMETER 100K | DAI | BA403-801 |
| 107        | IC54  | POTENTIOMETER 100K | DAI | BA403-801 |
| 108        | IC55  | POTENTIOMETER 100K | DAI | BA403-801 |
| 109        | IC56  | POTENTIOMETER 100K | DAI | BA403-801 |
| 110        | IC57  | POTENTIOMETER 100K | DAI | BA403-801 |
| 111        | IC58  | POTENTIOMETER 100K | DAI | BA403-801 |
| 112        | IC59  | POTENTIOMETER 100K | DAI | BA403-801 |
| 113        | IC60  | POTENTIOMETER 100K | DAI | BA403-801 |
| 114        | IC61  | POTENTIOMETER 100K | DAI | BA403-801 |
| 115        | IC62  | POTENTIOMETER 100K | DAI | BA403-801 |
| 116        | IC63  | POTENTIOMETER 100K | DAI | BA403-801 |
| 117        | IC64  | POTENTIOMETER 100K | DAI | BA403-801 |
| 118        | IC65  | POTENTIOMETER 100K | DAI | BA403-801 |
| 119        | IC66  | POTENTIOMETER 100K | DAI | BA403-801 |
| 120        | IC67  | POTENTIOMETER 100K | DAI | BA403-801 |
| 121        | IC68  | POTENTIOMETER 100K | DAI | BA403-801 |
| 122        | IC69  | POTENTIOMETER 100K | DAI | BA403-801 |
| 123        | IC70  | POTENTIOMETER 100K | DAI | BA403-801 |
| 124        | IC71  | POTENTIOMETER 100K | DAI | BA403-801 |
| 125        | IC72  | POTENTIOMETER 100K | DAI | BA403-801 |
| 126        | IC73  | POTENTIOMETER 100K | DAI | BA403-801 |
| 127        | IC74  | POTENTIOMETER 100K | DAI | BA403-801 |
| 128        | IC75  | POTENTIOMETER 100K | DAI | BA403-801 |
| 129        | IC76  | POTENTIOMETER 100K | DAI | BA403-801 |
| 130        | IC77  | POTENTIOMETER 100K | DAI | BA403-801 |
| 131        | IC78  | POTENTIOMETER 100K | DAI | BA403-801 |
| 132        | IC79  | POTENTIOMETER 100K | DAI | BA403-801 |
| 133        | IC80  | POTENTIOMETER 100K | DAI | BA403-801 |
| 134        | IC81  | POTENTIOMETER 100K | DAI | BA403-801 |
| 135        | IC82  | POTENTIOMETER 100K | DAI | BA403-801 |
| 136        | IC83  | POTENTIOMETER 100K | DAI | BA403-801 |
| 137        | IC84  | POTENTIOMETER 100K | DAI | BA403-801 |
| 138        | IC85  | POTENTIOMETER 100K | DAI | BA403-801 |
| 139        | IC86  | POTENTIOMETER 100K | DAI | BA403-801 |
| 140        | IC87  | POTENTIOMETER 100K | DAI | BA403-801 |
| 141        | IC88  | POTENTIOMETER 100K | DAI | BA403-801 |
| 142        | IC89  | POTENTIOMETER 100K | DAI | BA403-801 |
| 143        | IC90  | POTENTIOMETER 100K | DAI | BA403-801 |
| 144        | IC91  | POTENTIOMETER 100K | DAI | BA403-801 |
| 145        | IC92  | POTENTIOMETER 100K | DAI | BA403-801 |
| 146        | IC93  | POTENTIOMETER 100K | DAI | BA403-801 |
| 147        | IC94  | POTENTIOMETER 100K | DAI | BA403-801 |
| 148        | IC95  | POTENTIOMETER 100K | DAI | BA403-801 |
| 149        | IC96  | POTENTIOMETER 100K | DAI | BA403-801 |
| 150        | IC97  | POTENTIOMETER 100K | DAI | BA403-801 |
| 151        | IC98  | POTENTIOMETER 100K | DAI | BA403-801 |
| 152        | IC99  | POTENTIOMETER 100K | DAI | BA403-801 |
| 153        | IC100 | POTENTIOMETER 100K | DAI | BA403-801 |

| PARTS LIST |       |                    |     |           |
|------------|-------|--------------------|-----|-----------|
| REF        | DES   | DESCRIPTION        | MFR | MFR NO    |
| 154        | IC101 | POTENTIOMETER 100K | DAI | BA403-801 |
| 155        | IC102 | POTENTIOMETER 100K | DAI | BA403-801 |
| 156        | IC103 | POTENTIOMETER 100K | DAI | BA403-801 |
| 157        | IC104 | POTENTIOMETER 100K | DAI | BA403-801 |
| 158        | IC105 | POTENTIOMETER 100K | DAI | BA403-801 |
| 159        | IC106 | POTENTIOMETER 100K | DAI | BA403-801 |
| 160        | IC107 | POTENTIOMETER 100K | DAI | BA403-801 |
| 161        | IC108 | POTENTIOMETER 100K | DAI | BA403-801 |
| 162        | IC109 | POTENTIOMETER 100K | DAI | BA403-801 |
| 163        | IC110 | POTENTIOMETER 100K | DAI | BA403-801 |
| 164        | IC111 | POTENTIOMETER 100K | DAI | BA403-801 |
| 165        | IC112 | POTENTIOMETER 100K | DAI | BA403-801 |
| 166        | IC113 | POTENTIOMETER 100K | DAI | BA403-801 |
| 167        | IC114 | POTENTIOMETER 100K | DAI | BA403-801 |
| 168        | IC115 | POTENTIOMETER 100K | DAI | BA403-801 |
| 169        | IC116 | POTENTIOMETER 100K | DAI | BA403-801 |
| 170        | IC117 | POTENTIOMETER 100K | DAI | BA403-801 |
| 171        | IC118 | POTENTIOMETER 100K | DAI | BA403-801 |
| 172        | IC119 | POTENTIOMETER 100K | DAI | BA403-801 |
| 173        | IC120 | POTENTIOMETER 100K | DAI | BA403-801 |
| 174        | IC121 | POTENTIOMETER 100K | DAI | BA403-801 |
| 175        | IC122 | POTENTIOMETER 100K | DAI | BA403-801 |
| 176        | IC123 | POTENTIOMETER 100K | DAI | BA403-801 |
| 177        | IC124 | POTENTIOMETER 100K | DAI | BA403-801 |
| 178        | IC125 | POTENTIOMETER 100K | DAI | BA403-801 |
| 179        | IC126 | POTENTIOMETER 100K | DAI | BA403-801 |
| 180        | IC127 | POTENTIOMETER 100K | DAI | BA403-801 |
| 181        | IC128 | POTENTIOMETER 100K | DAI | BA403-801 |
| 182        | IC129 | POTENTIOMETER 100K | DAI | BA403-801 |
| 183        | IC130 | POTENTIOMETER      |     |           |

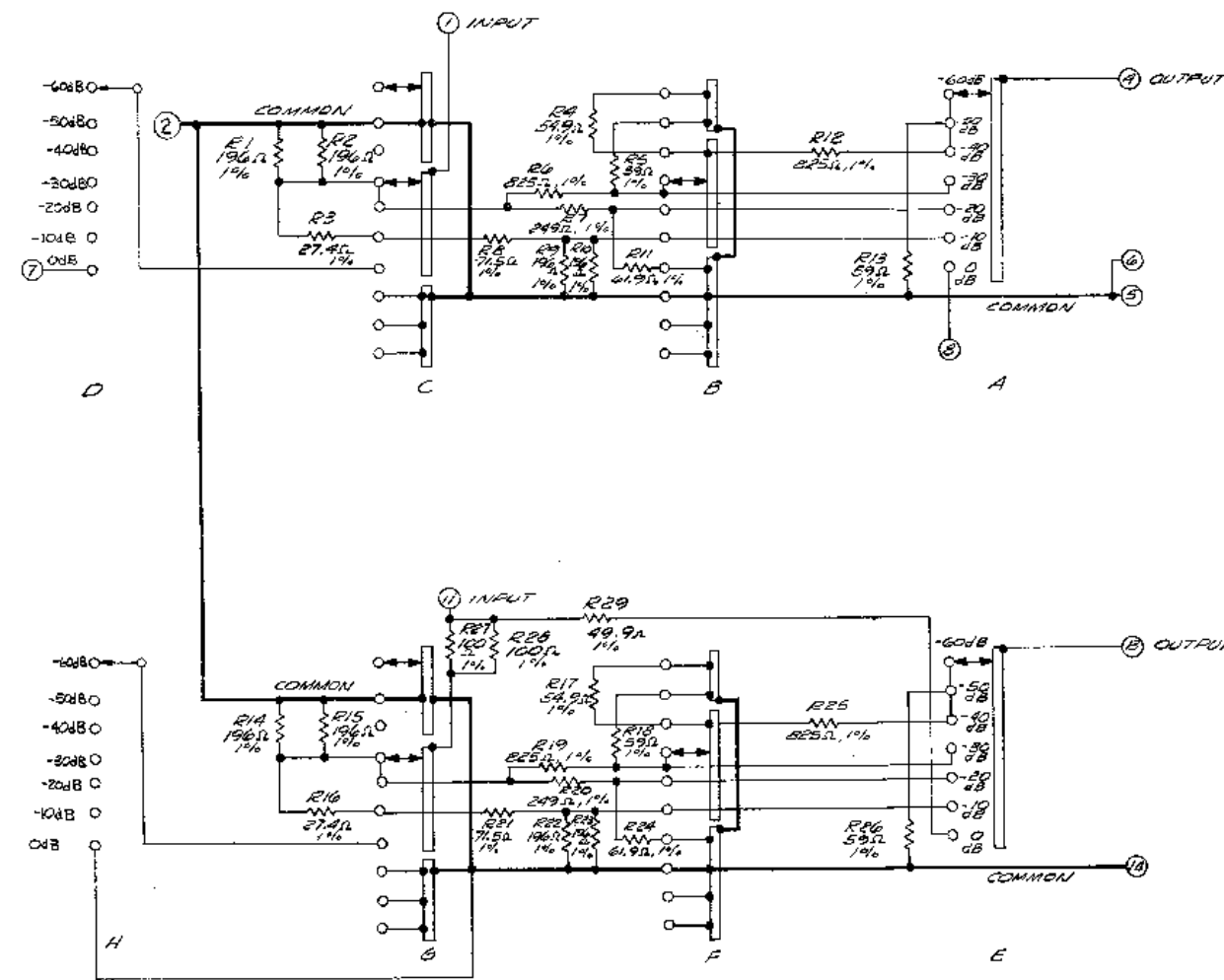




| PARTS LIST |                                           |                                 |         |          |     |
|------------|-------------------------------------------|---------------------------------|---------|----------|-----|
| ITEM       | REF. DES.                                 | DESCRIPTION                     | MFR     | MFR NO   | QTY |
| 1          | R3, R16                                   | RES. METAL FILM, 1/4W, 1%, 274Ω | CORNING | RN600    | 2   |
| 2          | R29                                       |                                 | 43.9Ω   |          | 1   |
| 3          | R4, R17                                   |                                 | 54.9Ω   |          | 2   |
| 4          | R5, R13<br>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<br>R10, R14<br>R15, R22<br>R23 |                                 | 196Ω    |          | 8   |
| 9          | R7, R20                                   |                                 | 249Ω    |          | 2   |
| 10         | R6, R12<br>R19, R25                       |                                 | 825Ω    |          | 4   |
| 11         |                                           |                                 |         |          |     |
| 12         |                                           |                                 |         |          |     |
| 13         |                                           |                                 |         |          |     |
| 14         |                                           |                                 |         |          |     |
| 15         |                                           | DETENT AND WAFER ASSY           | WAVETEK | 131A-SW1 | 1   |
| 16         |                                           |                                 |         |          |     |
| 17         |                                           |                                 |         |          |     |
| 18         |                                           |                                 |         |          |     |
| 19         |                                           |                                 |         |          |     |
| 20         |                                           |                                 |         |          |     |

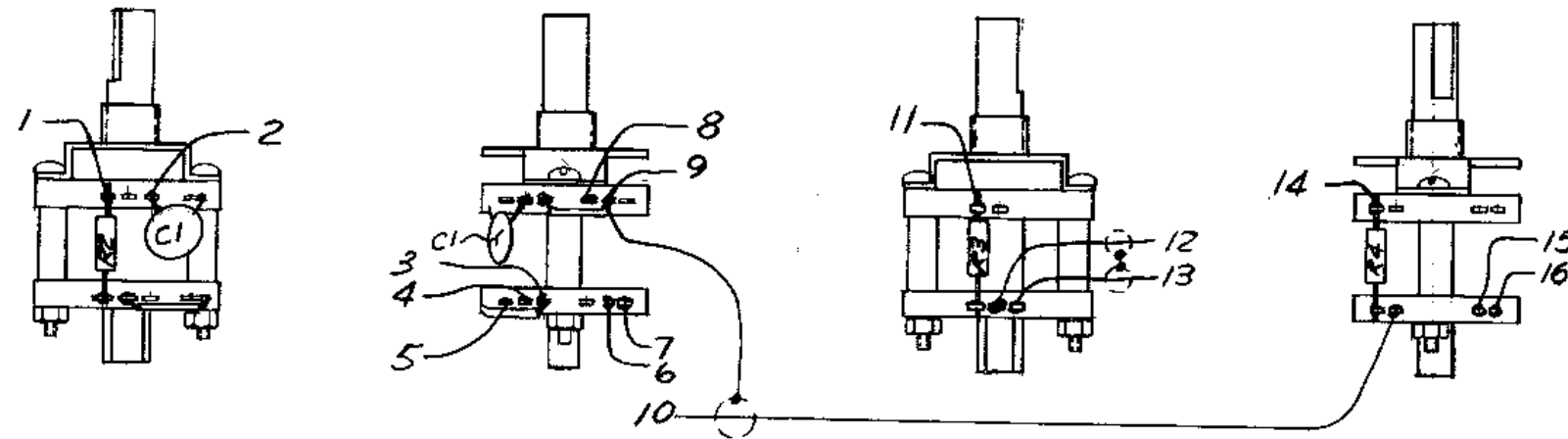
NOTES: UNLESS OTHERWISE SPECIFIED  
1. NUMBERS INDICATE WIRE TERMINATION  
POINTS SEE DISA-200

|                                                                                                                                                                                                                                 |                                   |                     |    |     |      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------|----|-----|------|
| tolerance unless<br>otherwise specified                                                                                                                                                                                         | rev                               | scr                 | by | dms | app. |
| .001 ± .010<br>.01 ± .030                                                                                                                                                                                                       |                                   |                     |    |     |      |
| scale FULL                                                                                                                                                                                                                      | by BOCHNIO                        | date 2-15-71        |    |     |      |
| material<br>N/A                                                                                                                                                                                                                 | title<br>ASSY -<br>ATTENUATOR SW. |                     |    |     |      |
| finish<br>N/A                                                                                                                                                                                                                   | model no.<br>131A                 | dwg no.<br>DISA-001 |    |     | rev  |
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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<br>otherwise specified | rev                                                                                                                                                                                                                             | scn       | by | date | app. |
| xxx ± 0.0<br>xx ± 0.05                  |                                                                                                                                                                                                                                 |           |    |      |      |
| scale <i>N/A</i>                        | WAVETEK san diego, calif                                                                                                                                                                                                        |           |    |      |      |
| material                                | by GRAY 2-12-74 JOP                                                                                                                                                                                                             |           |    |      |      |
|                                         | title<br>SCHEMATIC<br>ATTENUATOR                                                                                                                                                                                                |           |    |      |      |
|                                         | model no.                                                                                                                                                                                                                       | des. no.  |    |      |      |
|                                         | 131A                                                                                                                                                                                                                            | D131A-201 |    |      |      |
| finish <i>N/A</i>                       | this document contains proprietary information and<br>design rights belonging to WAVETEK and may<br>not be used or reproduced for any reason except<br>calibration, operation and maintenance without<br>written authorization. |           |    |      |      |



## NOTES:

1 FOR SCHEMATIC SEE D131A-200

| PARTS LIST |         |                                |         |           |     |
|------------|---------|--------------------------------|---------|-----------|-----|
| ITEM       | REF DES | DESCRIPTION                    | MFGR    | MFGR NO   | QTY |
| 1          | R2      | RES METALFILM 1/4W, 1% 49.9Ω   | CORNING | RN60D     | 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   |

|                                 |                                                                                                                                                                                                             |     |    |      |     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|------|-----|
| TOLERANCE UNLESS OTHERWISE SPEC | REV                                                                                                                                                                                                         | EDN | BY | DATE | APP |
| XX ± .010                       | WAVETEK SAN DIEGO, CALIF.                                                                                                                                                                                   |     |    |      |     |
| XX ± .010                       | DATE 2-16-71 BY G. J. G.                                                                                                                                                                                    |     |    |      |     |
| ANGLES .030                     | TITLE ASSY OUTPUT SWITCH                                                                                                                                                                                    |     |    |      |     |
| SCALE FULL                      | MODEL NO. 131A DWS 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                      |                                                                                                                                                                                                             |     |    |      |     |

