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SERVICE BULLETIN
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MODEL 420 A & D
FUNCTION GENERATOR

NOTICE

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To the best of our knowledge and at the time written, the information contained in this Service Bulletin is technically correct and the procedures accurate and adequate to effect the repair and to conduct the performance tests required to assure the unit's compliance with its original advertised specifications.

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National Service Manager
SIMPSON ELECTRIC COMPANY
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WARNING

Many of the tests required to troubleshoot, repair, and calibrate this equipment are inherently hazardous. Therefore, troubleshooting, repair, and calibration must be performed only by Simpson Authorized Service Centers.

SAFETY INFORMATION

The following markings and symbols are used in our Operator's Manuals, Service Bulletins and on the instruments to call attention to information important to the safe operation and maintenance of the instrument. These are national and international standard markings and are defined here for the benefit of anyone not yet familiar with them.

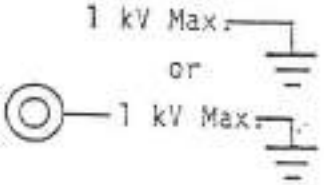
This symbol adjacent to another marking, terminal or operating device indicates that the operator must refer to the instruction manual for further information needed to avoid damage to the equipment and/or possible personal injury.

WARNING

This marking calls attention to an instruction which, if not followed correctly, may result in personal injury and/or damage to the premises.

CAUTION

This marking calls attention to an instruction which, if not followed correctly, may result in damage to the instrument.



This marking advises the user that the terminal(s) so marked must not be connected to a circuit point at which the voltage, with respect to earth ground, exceeds (in this case) 1000 V, AC or DC (unless otherwise noted). This voltage is the "maximum rated circuit-to-ground voltage" sometimes referred to as "common-mode" or "floating" voltage.

This symbol adjacent to one or more terminals identifies them as being associated with ranges that may in normal use be subjected to particularly hazardous voltages. For maximum safety, the instrument and its test leads should not be handled when these terminals are energized.

This symbol identifies a "protective" grounding terminal which must be connected to earth ground prior to making any other connections or to applying power to the instrument. In some countries the circle may be omitted.

This symbol represents voltage or current that alternates in polarity (AC).

This symbol represents voltage or current that is in one polarity only (DC).

This symbol represents voltage or current that may be either AC or DC.

This symbol is used to identify an instrument that employs "double-insulation" (IEC Class II) rather than protective grounding (IEC Class I) for protection from electric shock (no connection is made to earth ground).

SAFETY PRECAUTIONS

Read the Operator's Manual and the Service Bulletin carefully and completely. Beccme thoroughly familiar with the operation, specifications, safety precautions, etc., before operating, calibrating or servicing the Instrument.

Remember that dangerous voltages may appear unexpectedly or in unexpected places in defective equipment. A faulty bleeder resistor, for example, may not discharge a capacitor as intended. Before connecting to or disconnecting from a circuit, make certain that power to the circuit has been turned off and then discharge any and all capacitors and charge retaining devices (a long, unterminated cable, for example, may retain a charge) repeatedly until certain the charge has been dissipated.

Locate all voltage sources and accessibility paths prior to making any measurements or connections.

For your own safety, before each use, inspect the test leads, prods, connectors and power cable for cracks, breaks or crazes in the insulation. If any defects exist, destroy and replace the defective item(s) immediately.

When the instrument must be stored and/or transported in a vehicle in very cold weather, it will be subject to condensation when brought into a warm building. Therefore, do not attempt high voltage measurements until it is certain that the instrument has had time to dry completely.

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PART ONE

GENERAL INFORMATION AND SPECIFICATIONS

SCOPE

This manual contains the maintenance and repair procedures for the Simpson Model 420 A&D Function Generator. The service technician should completely understand the functions and theory of operation (explained in Part 3) before attempting any procedure contained herein. In case of difficulty the Function Generator should be returned to the factory.

GENERAL DESCRIPTION

The Simpson Model 420 Function Generator is a multiple waveform generator suitable for use in general electronic maintenance, production, school and laboratory. The Model 420 is capable of generating a sine, triangular or square waveform and TTL output simultaneously. The 1 to 10 Frequency dial in conjunction with seven frequency range switches, provides a wide frequency range (0.1 Hz to 1 MHz) for all functions. The external VCG (Voltage Controlled Generator) control and the continuously variable DC offset control with OFF position further increases the capability of the Instrument.

The 420 is available in two versions: 420A is the standard instrument designed to operate from a 120, 220 or 240 volt AC (50-60 Hz) power source (check rear panel designation) and the 420D is an optional version designed for either AC line operation or battery operation using nickel-cadmium cells. The battery can operate the Instrument for eight hours continuously. Recharging is automatic when the Instrument PWR switch is in the OFF position and with the line cord connected to an AC power source. (Refer to Part 2 for precautions and instructions. Hereafter all information and data applies to both Instruments).

TECHNICAL SPECIFICATIONS

Table 1-1

Specifications

1. GENERAL

Basic Outputs:	Sine, Triangle, Square, DC and TTL (separate BNC)
Frequency Range:	0.1 Hz to 1 MHz in seven ranges
Output Amplitude:	20V p-p open circuit (10V p-p into 600 ohms)
Output Amplitude Control:	Continuously variable, >30 dB; fixed attenuation, -30 dB

VCG Input:	±20V maximum, 2KΩ input impedance. Frequency decreases from dial setting with negative voltage
DC Offset:	Continuously variable with OFF position

2. SPECIFICATIONS

Dial Accuracy:	±5% F.S. overall
Sine Wave Distortion:	<1% 1 Hz to 100 kHz <2% at all other frequencies
Triangle Wave Non-Linearity:	<1% up to 100 kHz
Triangle Wave Non-Symmetry:	<1% up to 100 kHz
Square Wave Rise/Fall Time:	<100 ns into 600 ohms // 20 pF
Square Wave Non-Symmetry:	<1% up to 100 kHz
VCG Range:	≥300: 1 with 0 to -5V external signal, with 1000: 1 capability
TTL Output:	Fixed TTL compatible output will drive up to 10 TTL loads. < 25 ns rise/fall time
DC Offset:	Continuously variable, maximum of ±10V open circuit or ±5V into 600 ohms (maximum VAC + VDC without clipping). OFF position is provided
Output Impedance:	600 ohms, ±5%
Amplitude Flatness:	±0.1 dB to 20 kHz ±0.3 dB at all other frequencies, sine wave
Square Wave Aberration:	<3%

3. TEMPERATURE STABILITY (after 15 minutes warm-up time)

Frequency:	±0.1%/°C
Amplitude:	±0.05 dB/°C

4. LINE VOLTAGE STABILITY

Frequency:	±0.1% per ±10 VAC variation
Amplitude:	±0.05 dB per ±10 VAC variation

5. TEMPERATURE RANGE

Operation:	0 to +50°C
Storage:	-10 to +60°C

6. POWER REQUIREMENTS

120/220/240 VAC ±10%, 50/60 Hz
6 VA 4 "C" size nickel-cadmium batteries for D version only (8 hours of operation per full charge)

7. DIMENSIONS

Height:	2.70 in. (68.6mm)
Width:	8.40 in. (213.4mm)
Depth:	9.00 in. (228.6mm)

8. WEIGHT

3 lbs. (1.36 kg) - A Version

4 lbs. (1.82 kg) - D Version with batteries

PART TWO

INSTALLATION AND OPERATION

GENERAL

The instructions for use and operation of the 420 are contained in the Operator's Manual Part No. 6-111940. This section contains information concerning the general power requirements of the Model 420 and how they are provided. Battery and fuse replacement procedures are also included.

OPERATING POSITION

The Model 420 will operate set horizontally on its four rubber grommets or vertically on its back. The Instrument can also be set at an inclined angle by positioning the 8-position carrying handle under the unit. To set the Instrument at a desirable viewing angle use the following procedure:

1. Pull out both knobs (on sides of Instrument).
2. Rotate handle to one of eight positions.
3. Push both knobs into a locking position.

POWER REQUIREMENTS

The Model 420A is designed to be operated from the AC line only. The 420D is designed to be operated from either the AC line or self contained nickel-cadmium batteries, (not furnished with the instrument).

AC Line Operation

The 420 is wired at the factory for 120 VAC (50 to 60 Hz) operation.

CAUTION

For AC line operation ensure that the grounding pin of the power plug is securely connected to an earth (power line) ground. Use a 3-wire grounded outlet which conforms to the latest issue of the National Electrical Code.

Battery Operation (420D)

Battery operation is automatic; when batteries are installed, the line cord is disconnected and the power switch is in the ON position.

BATTERY INSTALLATION/REPLACEMENT

Battery specifications are given in Tables 1-1.

CAUTION

To avoid dangers associated with recharging batteries use only the type specified in Table 1-1. Do not attempt to use cadmium zinc, alkaline or the like that is not designed tn be recharged.

Install the cells as follows:

1. Remove bottom cover (Refer to Part Four), and install the four cells into the holder.

   Ensure that the cells are installed according to the polarity orientation designated on the battery holder label. Failure to do so can damage the 420D.

2. Check that the battery contacts are clean and making good contact .

3. Replace the bottom cover.

BATTERY CHARGING (420D)

The battery is being charged at full rate when the POWER switch is set to the OFF position and AC power is applied to the Instrument. Approximately 16 hours are required to fully charge the battery in this mode of operation.

NOTE: If the battery voltage is low, charge the battery with the POWER switch set to OFF for at least 15 minutes before operating the Instrument.

The battery is being "trickle" charged whenever the Instrument is operated from the AC power line.

FUSE REPLACEMENT

The line fuse is mounted inside the fuse holders on the main PC Board as shown in Figure 5-1 or 5-2. Use the following procedure to replace a fuse.

WARNING

Remove all power and input/output connections to the Instrument before removing bottom cover. Do not replace a blown fuse with one which has a larger rating or slower time lag characteristic than those specified.

Refer to Part Four for Bottom Cover Removal.

PART THREE

THEORY OF OPERATION

GENERAL

The 420 generates a basic triangular wave form signal by means of charging and discharging a capacitor by positive and negative current sources. A dual comparator and the associated latching circuit generates a signal to control the current sources. A square wave signal is derived from this control signal. A sine converter is used to convert a triangular wave form into a sine waveform. The output frequency depends upon the rate of charging and discharging a capacitor (Refer to Figure 3-1).

POWER SUPPLY (420A ONLY)

A positive full wave rectifier (D11 & D12) produces the unregulated +15V for regulators IC5 and IC6 to generate +12V and +5V respectively. A negative full wave rectifier (D13 & D14) supplies an input voltage for Q6 and IC7B to generate -12V.

POWER SUPPLY (420D ONLY)

A positive full wave rectifier (D18 & D19) produces a +9V unregulated power source for current source generator Q13 and IC9 to charge the batteries and power the DC-DC converter T2, Q14 and Q15.

The DC-DC converter generates ±15V for ±12V regulators IC 5 and Q6. A +4.75V regulated power supply replaces the regulated +5V power source.

FREQUENCY CONTROL AND VCG

The frequency dial controls the rate of charging and discharging of a capacitor in order to vary the output frequency. The voltage applied into the VCG IN also serves the same function.

NOTE: VCG-Voltage Controlled Generator

CURRENT SOURCE

The positive and negative CURRENT SOURCES IC2A, Q1 and IC7A, IC1 respectively, provide the charging and discharging of a timing capacitor.

RANGE-Hz TIMING CAPACITORS

Selecting one of these capacitors (C1 through C5) and IC2B changes the output frequency in decade steps.

CONTROL GATE

Diode gates D3 and D4 control the current sources for a timing capacitor depending upon the command of the CONTROL signal from latching circuitry IC4.

BUFFER AND LEVEL SHIFTER

For minimum loading a BUFFERING circuit consisting of Q2, Q3 and Q4 is used to provide a triangular wave signal pick-off point. A level shifter is required to produce symmetrical ± peak amplitudes.

COMPARATOR AND LATCH

The dual COMPARATOR IC3 detects the ± peak amplitudes of the triangular wave. When the positive peak is detected, IC4 latches to one of two states so that the positive CURRENT SOURCE is turned off allowing the timing capacitor to discharge by the negative CURRENT SOURCE and vice versa.

TTL BUFFER

The gate control signal is applied to one of the gates of IC4 to generate a TTL output.

NOTE: TTL - Transistor Transistor Logic

SINE CONVERTER

The triangular wave signal drives the differential amplifier IC8 into a non-linear operating region to produce a low distortion sine wave. Trim pots VR6 and VR7 are used to adjust for minimum distortion.

WAVEFORM SELECTORS

Depress one of these switches (H, J & K) to select one of the three WAVEFORMS available at 600Ω OUTPUT.

OUTPUT AMPLIFIER

The output amplifier, consisting of Q7 through Q11, provides amplification of the signal from the waveform selector switch, and is varied in amplitude by control VR11. The 600Ω OUTPUT can be reduced 30 dB depending upon the position of switch 1L. An external DC OFFSET control is also incorporated into the output amplifier in order to shift the base line of the output signal wave up and down from zero potential.

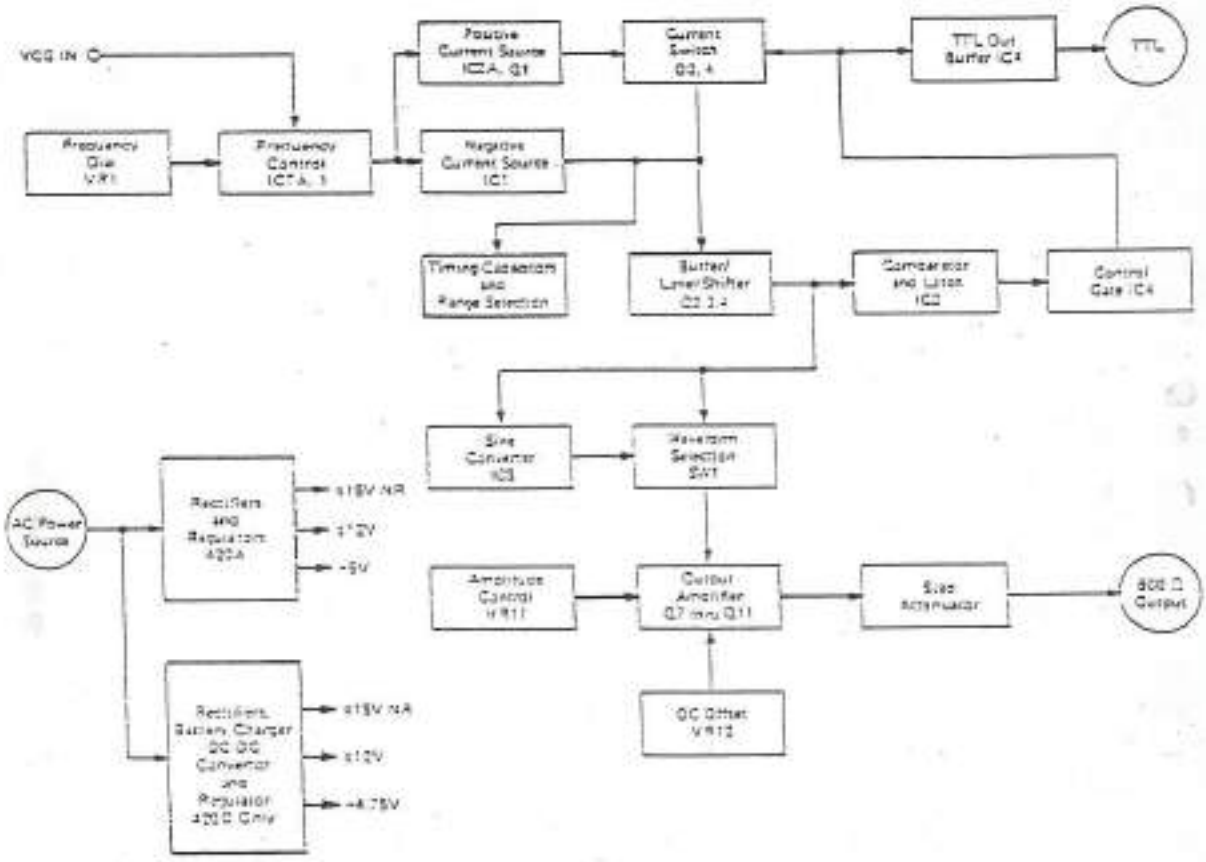


Figure 3-1

Functional Block Diagram Model 420

PART FOUR

MAINTENANCE

WARNING

Voltages can be encountered during the process of operating, calibrating, testing or servicing the Instrument that constitute a Shock Hazard. (Refer to Preface). Therefore, make sure that the GENERAL SAFETY PRECAUTIONS (Refer to Preface) are carefully read and understood before putting the Instrument into operation, performing maintenance, or any disassembly. Do not forget to perform the Hi-Pot leakage check of Part Four.

GENERAL

Procedures for disassembly, part replacement, calibration and performance testing are contained in this section. Before attempting any of the procedures in this section, maintenance personnel should be thoroughly familiar with the operator's manual, specifications, physical composition and theory of operation of the Model 420.

DISASSEMBLY PROCEDURES

Disassembly procedures are divided into five parts: cabinet housing, battery holder, circuit board, switches and control panel. Switching circuitry is attached to the circuit board and is accessible when the board is removed. Certain precautionary measures are required when removing the circuit board and switches.

Bottom Cover Removal

1. Remove all power and disconnect the line cord.
2. Place the Instrument upside down on a padded surface to prevent any scratching or marring of the cabinet.
3. Pull out both handle knobs from both sides of the Instrument and move the handle to any position that allows access to the rubber feet.
4. Remove the 4 screws (located in the rubber feet) using a small flat bladed screwdriver and carefully lift off the bottom cover and remove the handle; the circuit board and switches are now accessible.
5. To replace the bottom cover reverse these procedures.

Circuit Board Removal

1. Remove the bottom cover and handle as instructed.
2. Remove the 4 spacer studs using a 1/4 inch hex-nut driver and the 2 screws that secure the power transformer to the case.
3. Gently lift up the circuit board. Do not move any of the switch pushbuttons, or the front panel, for they are connected to the circuit board.
4. Reverse these procedures to replace the circuit board.

Battery Holder Removal (Model 4200 only)

1. Remove the bottom half of the case and handle.
2. Remove the batteries from the holder and unsolder the wires that connect to the circuit board at the terminals on the battery holder.
3. Remove the 4 screws that secure the holder to the 4 spacer studs mounted on the circuit board.
4. Lift the holder from its mountings.
5. To install the holder, reverse these procedures.

Switch Removal

1. Remove the bottom cover, handle, and circuit board.

*2. Using a desoldering tool, unsolder all the switch contacts on the switch being removed.

3. Release switch section being replaced by gently bending open retaining tabs of the switch frame.
4. Gently lift off the switch assembly noting the orientation.
5. Insert the new assembly into the same matching holes. Reset retaining tabs of switch frame.
6. Resolder the switch contacts.

*NOTE

When soldering the switch contacts, be sure to use a small iron. Do not overheat the contacts.

7. Perform an operational test. If the unit passes this test, install the unit in the cabinet and it is ready for use.

CALIBRATION

Test Equipment Required or equivalent

1. Tektronix Model 545B oscilloscope with Model 1A1 preamplifier.
2. Simpson Model 461 DVOM.
3. Simpson Model 7026 Frequency Counter.
4. HP Model 339A Distortion Measurement Set.
5. Trimmer Alignment Tool (GC8276 or equiv.).
6. Power Resistor (2 watt/1%) 30Ω, and 56Ω (Model 4200 only).
7. BNC "T" connector.
8. Variable Voltage Supply (0 to -4VDC).

Power Supply Adjustment

1. Center all potentiometers and variable capacitors.

WARNING

When performing adjustments within the instrument, use insulated tools and do not put hands near portions of the circuit that operate at 30V or more.

2. Push the power pushbutton to OFF and then connect the unit to an AC power source.
3. Model 420 Calibration:
   - A. Apply power to the model 420A and note that the LED on the front panel indicates that the unit is energized.
   - B. Check the output voltages as shown in Table 4-1.

Table 4-1
Output Voltages
Model 420

TEST POINT	VOLTAGE LIMITS
1	+15V to +19V
2	-15V to -19V
*3 A.	+4.75V to +5.25V
B.	+4.74V to +4.78V
4	+11.4V to +12.6V
5	-11.4V to -12.6V

*NOTE: Test points printed on PC Board.

4. Model 4200:

   A. Observing polarity, connect the Simpson Model 461 (DC current function) across the battery holder of the unit under test with the 30 ohm power resistor connected in series.

   B. Adjust potentiometer VR14 (on DC-DC converter board) until the meter indicates 165 to 170mA DC (make sure the power switch is in the OFF position).

   C. Remove the 30 ohm power resistor and connect the 56 ohm power resistor across the battery holder.

   D. Change the Model 461 function to DC voltage and the voltage across the battery holder should be 6.6 to 7.5VDC.

Symmetry Adjustment

1. Set the controls of the Model 545B Oscilloscope as follows:

   A. TIME/CM: 5uSec/cm

   B. VARIABLE: cal.

   C. TRIGGER: + slope/ALT mode.

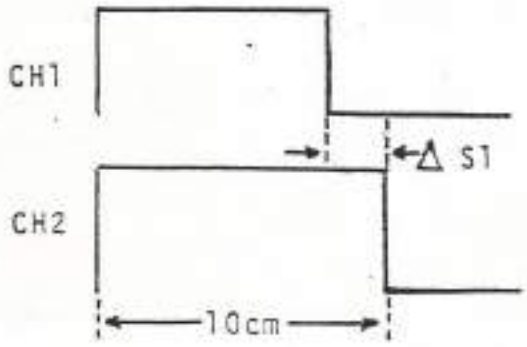
   D. VOLTS/CM: 1V (both channels).

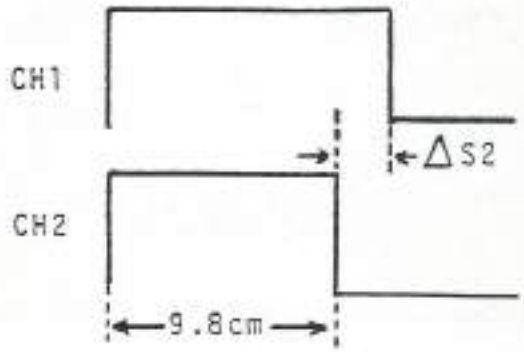
   E. CHANNEL 2: Inverted.

2. Connect the Model 420 TTL output through the "T" connector to Channels 1 and 2 of the Model 545B test oscilloscope.

3. Depress the FREQUENCY RANGE X1K pushbutton and set the FREQUENCY DIAL to 10.

4. Adjust the TRIGGER LEVEL control on the Model 545B to obtain the following displays:





5. Adjust potentiometer VR4 until ΔS1=0.1cm to 0.2cm (0.5 to 1 increment).

6. Rotate the FREQUENCY DIAL to 1 and change the TIME/CM control of the Model 545B as necessary to obtain the same displays as those for step 4 in above diagram.

*7. Adjust potentiometer VR3 until ΔS2=0.15cm to 0.2cm (0.75 to 1 increment).

8. Repeat steps 3 thru 7 again and check for trace shift.

*NOTE

If ΔS2 cannot be properly adjusted diode D21 on the DC-DC converter board should be replaced by a jumper (shorted out).

Internal DC Offset Adjustment

1. Set the Model 420 controls as follows:

   A. Waveform switches released: (all in the out position).

   B. FREQUENCY RANGE X100 pushbutton: depressed.

   C. DC OFFSET: OFF.

   D. AMPLITUDE: MAXIMUM.

   E. Step Attenuator (0,-30db) pushbutton: depressed.

   F. FREQUENCY DIAL: at 10.

2. Set the controls of the Model 545B oscilloscope as follows:

   A. TIME/CM: .5mSec/cm.

   B. VARIABLE: CAL.

   C. VOLTS/CM: .2V/cm.

   D. CHANNEL SELECTION: CH-1, DC coupled.

3. Connect the OUTPUT jack of the Model 420 to the Model 545B through a direct cable.

4. With channel 2 input switch on the HP545B slope released and grounded, the channel 2 trace appears as a straight line. Adjust VR13 on the Model 420 until the channel 1 trace is in line with the channel 2 base line trace within a plus or minus value of 20mV. (.5 increments marks.)

5. Set the VOLTS/CM control of the 545B to the 5V/CM position and then depress the TRIANGLE WAVEFORM switch on the Model 420. The oscilloscope should display a triangular waveform with an amplitude of 4cm ±.3cm (peak to peak) without any clipping.

External DC Offset Adjustment

1. Switch the OC OFFSET switch ON and rotate the control from the extreme CCW position to the extreme CW position.

2. The triangular waveform on the 5458 should be shifted at least from -9V to +9V and no clipping should be evident between ±10V.

Square Wave Adjustment

1. Set the Model 545B VOLTS/CM control to the 5V/CM position.

2. Set the AMPLITUDE control of the Model 420 to its MAX. position and depress the SQUARE WAVEFORM switch.

3. Adjust potentiometer VR10 until the displayed square wave has equal ± peak amplitudes (refer to the zero volt baseline by switching the coupling switch to the GND position as necessary) ±2 increments.

4. Adjust potentiometer VR9 until the square wave has an amplitude of 3.8cm to 4.3cm peak to peak.

5. Set the AMPLITUDE control of the Model 420 to the MIN. position and set the VOLTS/CM control of the 545B to the .2V/CM position.

6. Readjust potentiometer VR10 for equal peak amplitudes (±1 increment) of the square wave.

Frequency Calibration

1. Rotate the FREQUENCY DIAL to the extreme CW position. Check and re-align the 6.75 point on the dial as necessary with the vertical line straight down from the printed arrowhead on the front panel.

2. Set the FREQUENCY DIAL to the 10 position and depress the FREQUENCY RANGE X100 pushbutton.

3. Connect the TTL output to a frequency counter (Simpson Model 7026). And ajust potentiometer VR2 until the counter indicates 998Hz to 1002Hz.

4. Check the remaining frequency ranges, readjusting VR2 as necessary in accordance with Table 4-2.

Table 4-2
Frequency Ranges
Model 420

FREQUENCY RANGE	FREQUENCY DIAL	COUNTER READING LIMITS*
X1K	10	9.75kHz to 10.25kHz
X10K	10	97.5kHz to 102.5kHz
X10	10	98Hz to 102Hz
X1	10	96mSec to 104mSec
X.1	10	960mSec to 1040mSec

*NOTE: These readings are for calibration only. The Model 420 should have a F.S. accuracy of ±5%.

*NOTE

If the counter reading is not within the limits indicated in Table 4-2, readjust VR2 until the counter indicates the nearest limit. For example, with the FREQUENCY RANGE X10K pushbutton selected and the FREQUENCY DIAL set to 10, the counter indicates 96kHz. Readjust VR2 until the counter reads 97.5kHz. If the first reading was 104kHz, readjust VR2 until the counter indicates 102.5kHz.

5. Depress the FREQUENCY RANGE X100K pushbutton and leave the FREQUENCY DIAL set to the 10 position.

6. Adjust capacitor C5 until the counter reads 999kHz to 1005kHz. If the reading is not obtainable, adjust to the minimum reading possible which should not exceed 1035kHz. Record this reading for later reference.

7. Set the FREQUENCY DIAL to the 1 position and the counter should indicate between 70kHz and 90kHz. If not, realign the FREQUENCY DIAL as follows:

   A. If the indication is less than 70kHz, repeat step 1 except the FREQUENCY DIAL is aligned to 6.5.

   B. If the indication is between 90kHz and 150kHz repeat step 1 except the FREQUENCY DIAL is aligned to 7.

   C. If the indication is greater than 150kHz, repeat step 1 except the FREQUENCY DIAL is aligned to 7.25.

9. Set the FREQUENCY DIAL to the 10 position and readjust VR2 until the counter indicates the same reading as in step 6.

10. Set the FREQUENCY DIAL to the 1 position and the reading should be between 75kHz and 135kHz.

Sine Wave Distortion Adjustment - Preliminary

1. Set the VOLTS/CM control of the Model 5458 oscilloscope to the 2V/CM position and the coupling selector to the DC position.

2. Depress the SINE WAVEFORM switch on the Model 420 and rotate the AMPLITUDE control to mid-range.

3. Adjust potentiometer VR8 for an equal ± peak amplitude (in relation to the zero volt input trace display ±1 increment).

4. Adjust potentiometers VR6 and VR7 to obtain a good sine waveform display on the Model 5458 oscilloscope.

Sine Wave Distortion Adjustment

NOTE

The following procedure is based on the use of HP Model 339A with auto-set level and automatic fine tuning.

1. Set the controls of the HP Model 339A as follows:

   A. Function: Distortion.

   B. Filters: all out.

   C. Analyzer inputs: Dis AN.

   D. Meter: Distortion Range to 100%, Input Range to 10.

   E. Frequency: 10.0 x 1kHz.

2. Set the controls on the Model 420 as follows:

   A. Output Waveform: Sine.

   B. 0db/-30db Attenuator switch: Depressed.

   C. Amplitude control: Mid-Range.

   D. Frequency Dial: 10.

   E. Frequency Range X1kHz: Depressed.

   F. DC offset control: OFF.

3. Connect the Model 420 600Ω output to the Distortion Analyzer input of the HP Model 339A.

4. Adjust potentiometers VR6 and VR7 on the Model 420 to obtain the minimum distortion possible (less than .8%).

5. Change the Distortion Range on the Model 339A to 10% and then 3% while repeating step 4 for best results. If the distortion is between .8% and 1%, check the distortion at 100kHz and 100Hz making sure the distortion remains less than 1%.

6. Return the Distortion Range setting on the Model 339A to 100%.

Sine Wave Amplitude Adjustment

1. Set the VOLTS/CM control on the Model 545B to the 5V/CM position.

2. Rotate the AMPLITUDE control of the Model 420 to the MAX. position.

3. Connect the Model 420 output to the Model 545B input through a direct cable.

4. Adjust potentiometer VR5 to obtain a deflection of 4cm ±.2cm peak to peak.

5. Rotate the AMPLITUDE control of the Model 420 to the MIN. position, and change the position of the Model 5458 VOLTS/CM control to .2V/CM.

6. Adjust potentiometer VR8 for equal ± peak amplitudes (with reference to the zero volt baseline of the scope ±1 increment) be sure the Model 545B is set for DC coupling).

Frequency Response and VCG

1. Set the controls of the Model 5458 oscilloscope as follows:

   A. VOLTS/CM: .5V.

   B. TIME/CM: 20μSec/CM.

2. Set the controls of the Model 420 as follows:

   A. AMPLITUDE: MAX.

   B. DC OFFSET: OFF.

   C. FUNCTION: SINE.

   D. FREQUENCY RANGE X10K switch depressed.

   E. FREQUENCY DIAL: 10.

3. Connect a compensated X10 probe from the output of the Model 420 to the input of the Model 5458.

4. Adjust the variable VOLTS/CM control on the Model 5458 to obtain a display with 4cm vertical deflection.

5. Apply voltage from the variable voltage source to the VCG IN of the Model 420.

6. Vary the applied voltage between 0 and -2V. The output frequency of the Model 420 will change as the voltage varies but the 4cm vertical deflection should not change more than .1cm.

Square Wave Response

1. Set the controls of the Model 420 as follows:

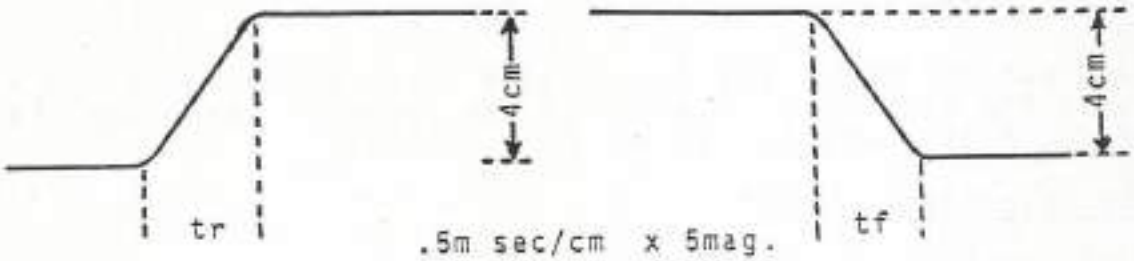
   A. FREQUENCY RANGE X100K pushbutton depressed.

   B. FREQUENCY DIAL: 10.

   C. FUNCTION: SQUARE.

2. Set the TIME/CM control of the Model 545B to the .5μSec/CM position.

3. Adjust the TRIGGER LEVEL, VARIABLE VOLTS/CM, HORIZONTAL POSITION, and X5 magnifier controls of the Model 5458 to obtain waveforms as shown below.



4. The Rise time (tr) and Fall time (tf) should be less than 1cm (100nSec).

TEST EQUIPMENT

The "HI-POT" (high potential tester) used for these tests must be a so called "non-destructive" type designed especially to limit the test current and to reduce the risk of injury to the operator from accidental electric shock. Avoid homemade power supplies - they can be dangerous if not designed for the purpose.

HI-POT TEST PROCEDURE

WARNING

Keep hands and body away from test leads, the 420 and the bench while the testing is in process.

1. Insure that the power switch of the Hi-Pot Tester is set to OFF position and voltage control set to "0" position.
2. Connect as in Figure 4-1A.
3. Turn the power switch of Hi-Pot Test Set to the "ON" position.
4. Slowly and steadily advance the voltage control of the Hi-Pot Test Set to 1200 VOLTS RMS, maintain for 1 second. (Observe for possible failure as indicated by a sudden increase of the test current or a sudden decrease or inability to increase the test voltage). Also be alert to any buzzing within the Instrument being tested.
5. If no failure occurs slowly reduce the voltage of the Hi-Pot Test Set to "0".
6. Turn the power switch of the Hi-Pot Test Set to OFF.

CAUTION

Never turn the Hi-Pot Tester POWER switch OFF while the test voltage is being applied. The resulting transient may damage the Instrument being tested and a faulty unit may unknowingly be shipped to the customer. When the Hi-Pot Tester voltmeter indicates zero volts, disconnect the test leads.

A failure of the test indicates a fault in the unit that must be corrected and re-tested before returning the unit to the customer.

NOTE

Hi-Pot Testing can be harmful to the unit being tested. Do not repeat a test more than once.

7. Remove the Hi-Pot test leads from the power plug and proceed to the Leakage Test.

HI-POT TEST

Insulation Withstanding Voltages

GENERAL

This test must be performed after any and all repair or calibration. These tests relate to user safety. Before final assembly make sure all excess solder, lead clippings and other debris has been removed. Note that transformer terminals, on-off switch terminals and fuse terminals are all free from solder bridging and are not unduly close to chassis or other conductors, also that all wire insulation is proper and intact.

WARNING

The following tests involve voltages which can be dangerous and fatal. Therefore before proceeding, read and be sure to understand the applicable precautions and procedures.

PRECAUTIONS

1. Do not perform these tests without another person in attendance who knows you are working with high voltages, and who knows emergency procedures in case of electrical shock.

2. Become thoroughly familiar with the operation of the Hi-Pot Test Set. Know the proper and safe operation of all controls.

3. Never touch any of the high voltage leads, or any parts connected to the leads when the Hi-Pot Test Set is switched "ON" and its terminals energized.

4. Place the instrument to be tested on the large sheet of insulating material used with the Hi-Pot Test Set. Check that no part of the instrument under test extends close to or overlaps the insulating sheet, and applicable cords, cables, accessories.

5. Always start the test at zero voltage ("0" setting on dial adjustment) and advance control slowly to the correct test voltage or to the point where a failure occurs.

6. When the test is completed or a failure has occurred, lower the voltage control slowly.

7. Except in emergency, do not switch the power on or off when the voltage control of the Hi-Pot Test Set is at a setting other than "0", as such transient disturbances can cause misleading indications.

8. While conducting a test, use only one hand to turn the voltage controls, keep the other hand in your pocket. DO NOT contact the bench, equipment, pipes or any grounded metal surface with any part of your body.

AC LEAKAGE TEST

1. Insulate the Model 420 from ground by placing it on an insulating pad.

2. Connect the Leakage Tester as shown in Figure 4-1B.

*3. Isolate the third wire of the Model 420 power cord from ground.

4. Connect the Simpson Model 229-2 from power line ground to the isolated third wire of the 420 per Figure 4-1B.

5. Connect the "Hot" and "Common" lead of the power cord to the 120V AC line and turn on the power.

6. Measure leakage current on the 229-2. Maximum allowed .5ma. (.05ma normal).

7. Record results, turn off the power, disconnect the equipment from the AC line and, restore the Instrument and Test Equipment to normal operating conditions.

* See note on Figure 4-1B for this step.

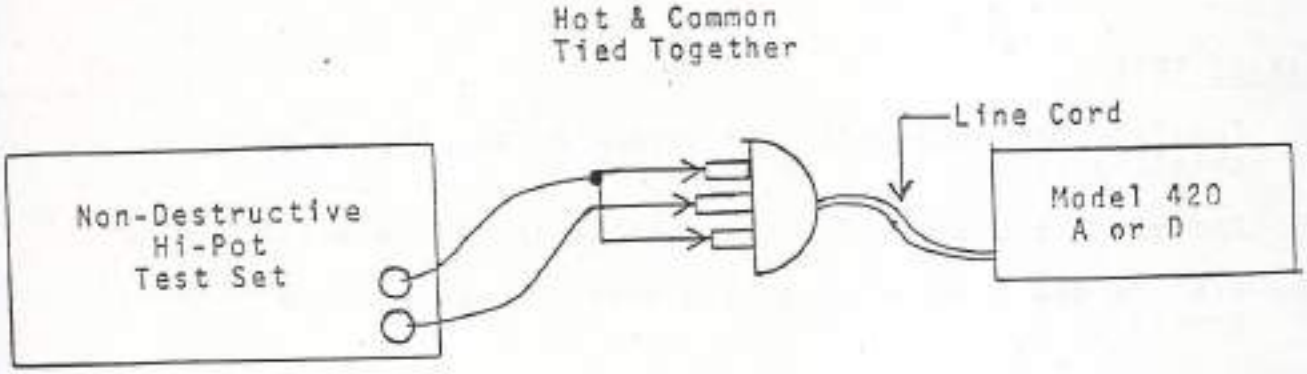


Figure 4-1A Hi-Pot Test, Power Transformer & Line Cord

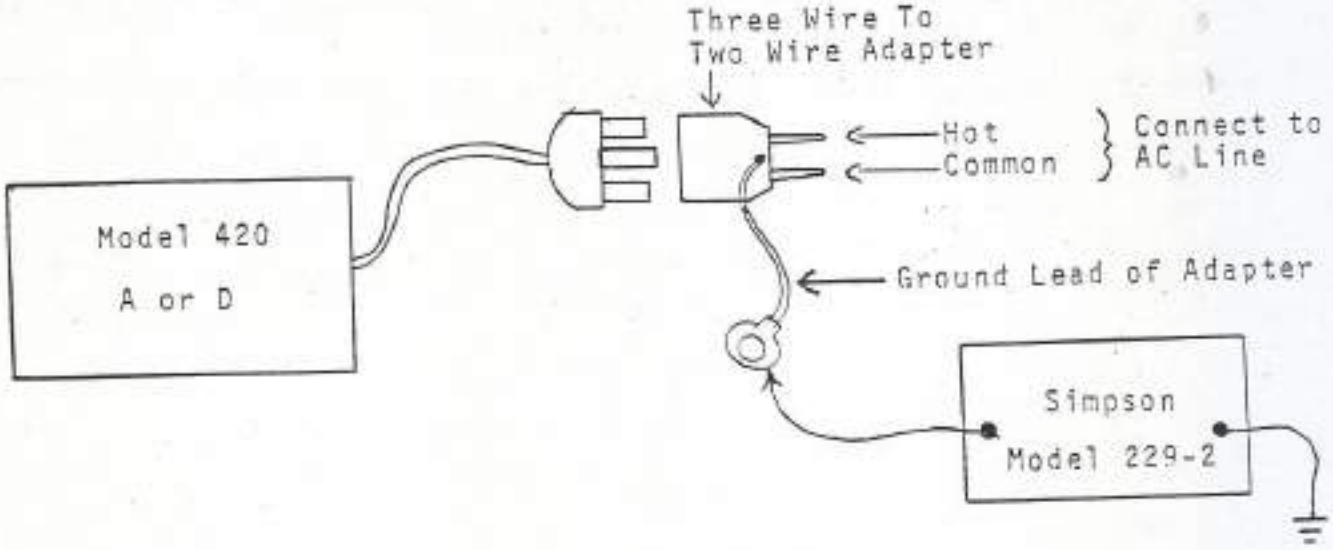


Figure 4-1B AC Leakage Test

FIGURE 4-1
CONNECTIONS FOR HI-POT AND AC LEAKAGE TEST

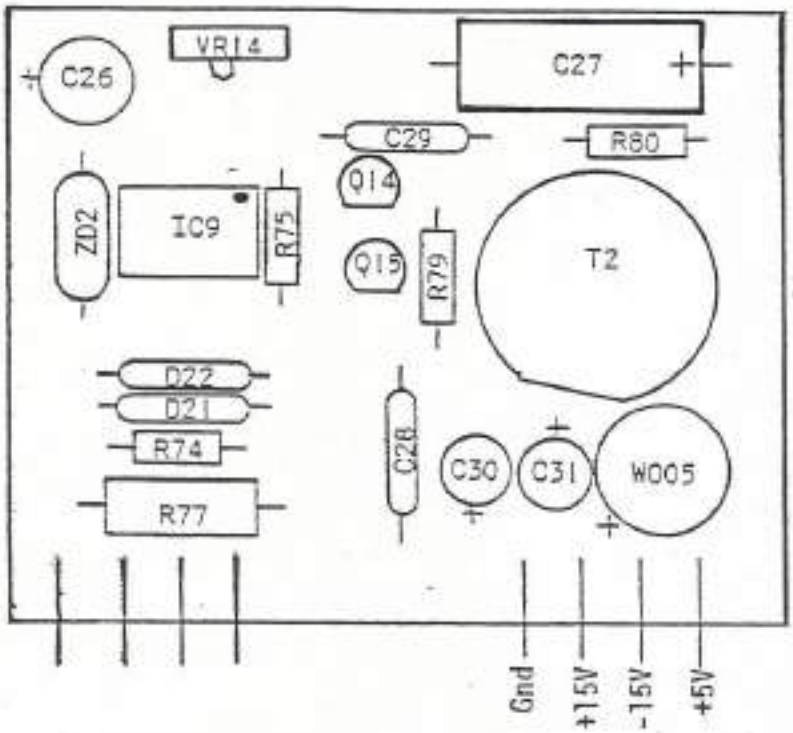


FIGURE 5-3
DC-DC CONVERTER BOARD
PARTS LOCATION (420D ONLY)

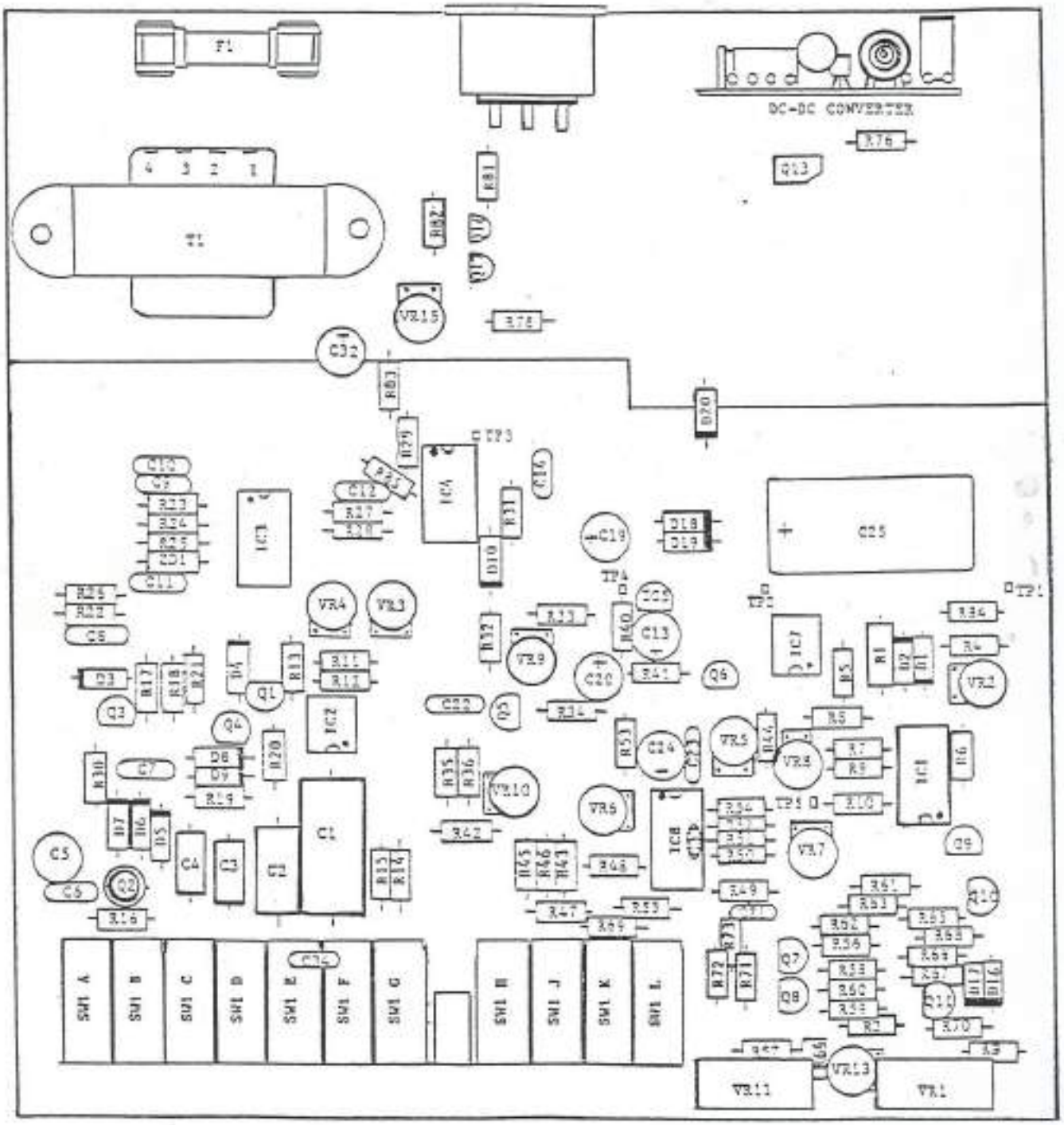


FIGURE 5-2
PARTS LOCATION MODEL 420D

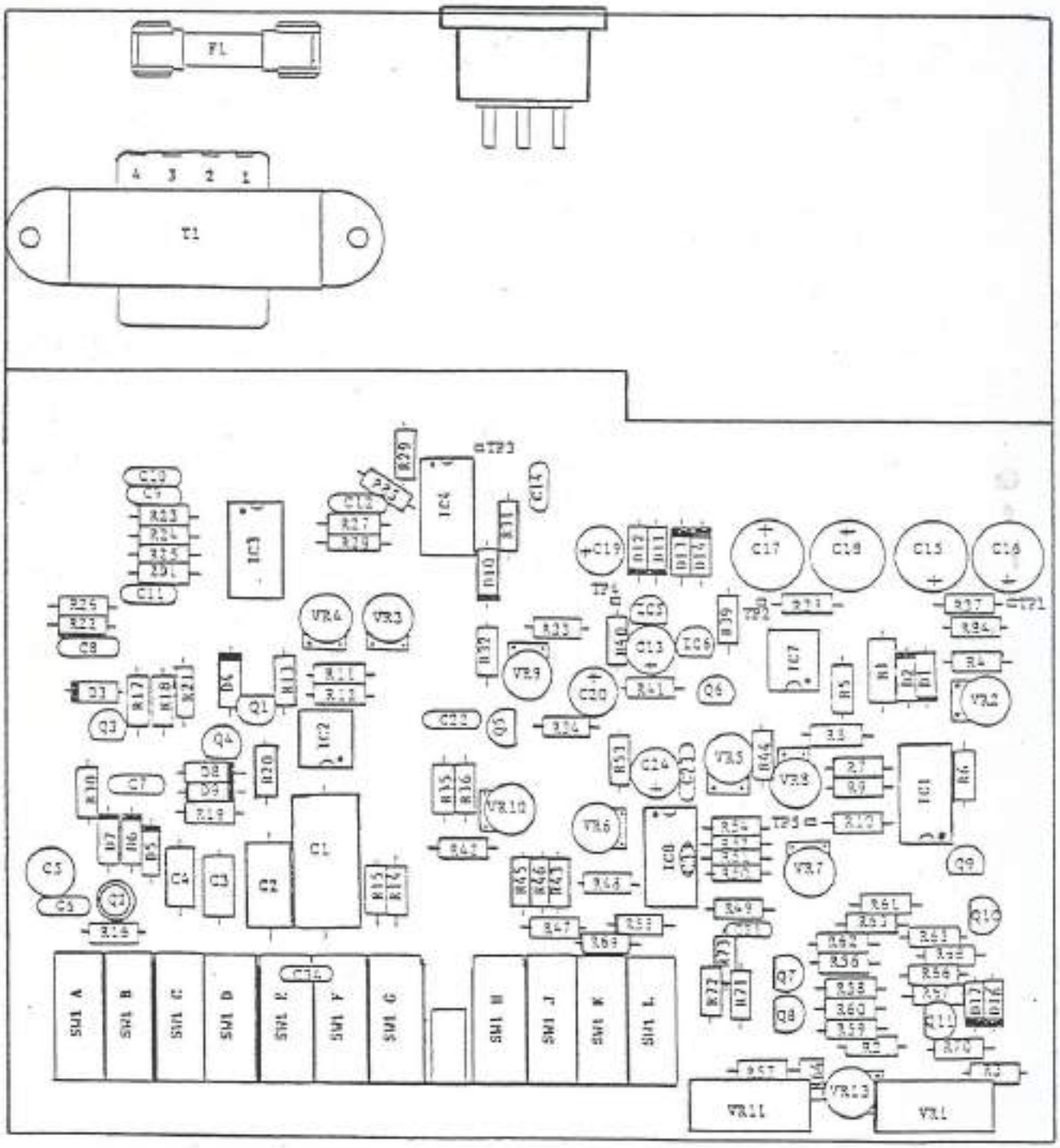
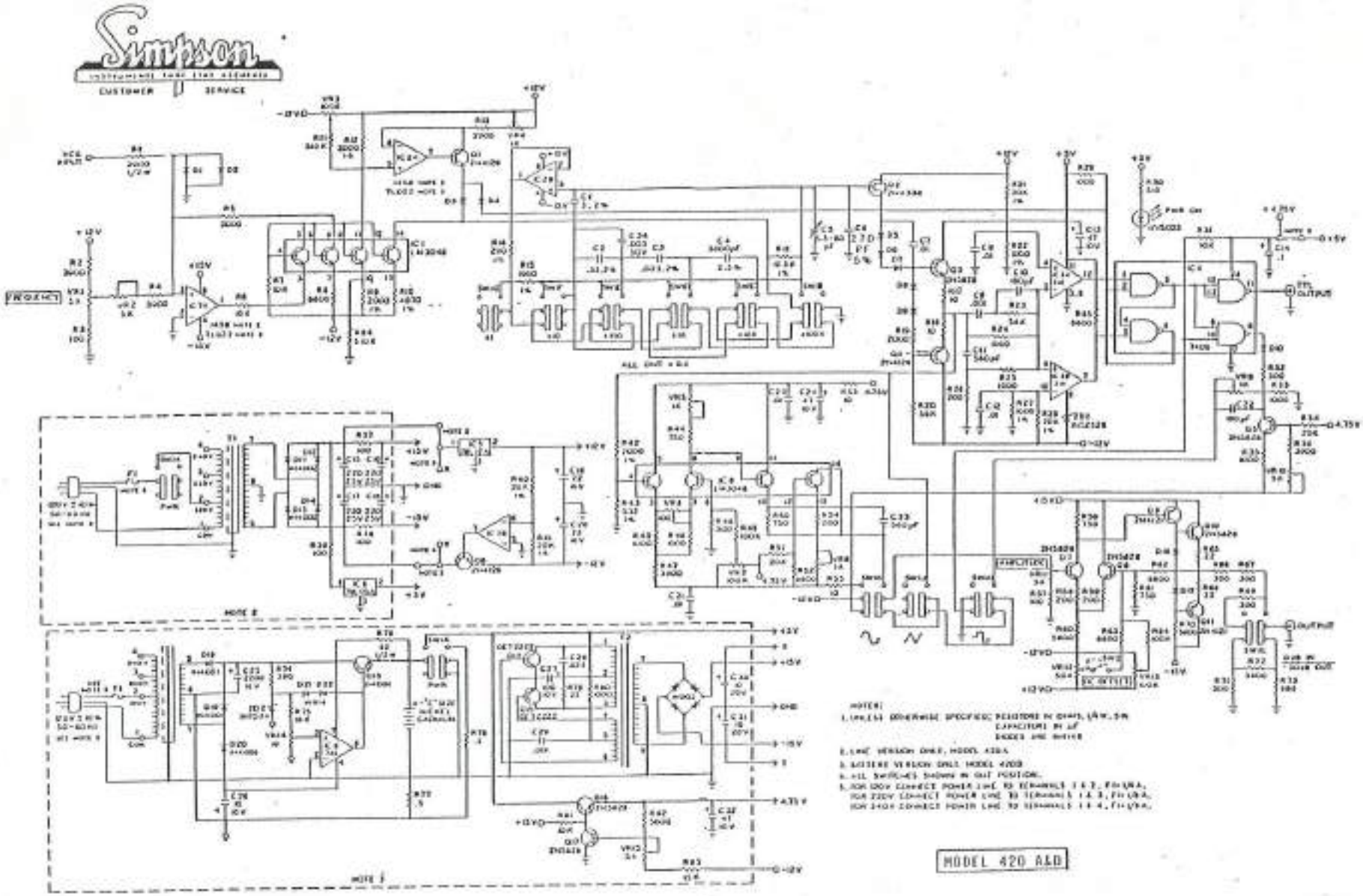


FIGURE 5-1
PARTS LOCATION MODEL 420A


Simpson
CUSTOMER SERVICE
MODEL 420 A&D

SIMPSON ELECTRIC COMPANY
853 DUNDEE AVENUE
ELGIN, ILLINOIS 60120
PHONE 697-2260

DIGITAL/OSCILLOSCOPE/SPECIAL PRODUCTS

FUNCTION GENERATOR 1981 - MODELS 420 A&D

PART NUMBER	DESCRIPTION		PRT REF	SPECIAL INFORMATION
	PC BD MAIN ASSEM M42C-A&C			
10-864525	PC BD ASSEM MAIN M42C-A			120V
10-864526	PC BD ASSEM MAIN M42C-A			220V
10-864527	PC BD ASSEM MAIN M42C-A			240V
10-864534	PC BD ASSEM MAIN M42C-D			120V
10-864535	PC BD ASSEM MAIN M42C-D			220V
10-864536	PC BD ASSEM MAIN M42C-D			240V
05-119349	RES 2K	1/2W 5.0%	R1	
05-114974	RES 3.9K	1/4W 5.0%	R2	
05-118152	RES 100.0 OHM	1/4W 5.0%	R3	
05-114974	RES 3.9K	1/4W 5.0%	R4	
06-110093	RES 2K	1/4W 5.0%	R5	
05-118161	RES 10K	1/4W 5.0%	R6	
05-118161	RES 10K	1/4W 5.0%	R7	
05-118256	RES 6.8K	1/4W 5.0%	R8	
05-115500	RES 2K	1/8W 1.0%	R9	
06-110551	RES 4.87K	1/8W 1.0%	R10	
06-110844	RES 510K	1/4W 5.0%	R11	
05-115500	RES 2K	1/8W 1.0%	R12	
06-110093	RES 2K	1/4W 5.0%	R13	
05-119741	RES 200.0 OHM	1/8W 1.0%	R14	
06-111965	RES 1.96K	1/8W 1.0%	R15	
05-116504	RES 19.6K	1/8W 1.0%	R16	
05-119670	RES 10.0 OHM	1/4W 5.0%	R17	
05-119670	RES 10.0 OHM	1/4W 5.0%	R18	
06-110093	RES 2K	1/4W 5.0%	R19	
05-118167	RES 56K	1/4W 5.0%	R20	
05-116621	RES 20K	1/8W 1.0%	R21	
01-117058	RES 1K	1/8W 1.0%	R22	
05-118167	RES 56K	1/4W 5.0%	R23	
05-118155	RES 1K	1/4W 5.0%	R24	
05-118155	RES 1K	1/4W 5.0%	R25	
05-119740	RES 200.0 OHM	1/4W 5.0%	R26	
01-117058	RES 1K	1/8W 1.0%	R27	
05-116621	RES 20K	1/8W 1.0%	R28	
05-118155	RES 1K	1/4W 5.0%	R29	
05-114965	RES 510.0 OHM	1/4W 5.0%	R30	
05-118161	RES 10K	1/4W 5.0%	R31	
05-119630	RES 300.0 OHM	1/4W 5.0%	R32	

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FUNCTION GENERATOR 1981 - MODELS 420 AND

PART NUMBER	DESCRIPTION		PRT REF	SPECIAL INFORMATION
05-119630	RES 300.0 OHM	1/4W 5.0%	R32	
05-118155	RES 1K	1/4W 5.0%	R33	
05-119645	RES 20K	1/4W 5.0%	R34	
05-118155	RES 1K	1/4W 5.0%	R35	
05-114974	RES 3.9K	1/4W 5.0%	R36	
05-118152	RES 100.0 OHM	1/4W 5.0%	R37	M420A ONLY
05-118152	RES 100.0 OHM	1/4W 5.0%	R38	M420A ONLY
05-118152	RES 100.0 OHM	1/4W 5.0%	R39	M420A ONLY
05-116621	RES 20K	1/8W 1.0%	R40	
05-116621	RES 20K	1/8W 1.0%	R41	
05-115500	RES 2K	1/8W 1.0%	R42	
05-118047	RES 332.0 OHM	1/8W 1.0%	R43	
05-119760	RES 750.0 OHM	1/4W 5.0%	R44	
05-118155	RES 1K	1/4W 5.0%	R45	
05-118155	RES 1K	1/4W 5.0%	R46	
05-114974	RES 3.9K	1/4W 5.0%	R47	
05-119630	RES 300.0 OHM	1/4W 5.0%	R48	
05-118168	RES 10CK	1/4W 5.0%	R49	
05-119760	RES 750.0 OHM	1/4W 5.0%	R50	
05-119645	RES 20K	1/4W 5.0%	R51	
05-118256	RES 6.8K	1/4W 5.0%	R52	
05-119670	RES 10.0 OHM	1/4W 5.0%	R53	
05-119740	RES 200.0 OHM	1/4W 5.0%	R54	
05-119670	RES 10.0 OHM	1/4W 5.0%	R55	
05-119760	RES 750.0 OHM	1/4W 5.0%	R56	
05-118152	RES 100.0 OHM	1/4W 5.0%	R57	
05-119740	RES 200.0 OHM	1/4W 5.0%	R58	
05-119740	RES 200.0 OHM	1/4W 5.0%	R59	
05-118257	RES 5.6K	1/4W 5.0%	R60	
05-119760	RES 750.0 OHM	1/4W 5.0%	R61	
05-118256	RES 6.8K	1/4W 5.0%	R62	
05-118256	RES 6.8K	1/4W 5.0%	R63	
05-118168	RES 10CK	1/4W 5.0%	R64	
05-115509	RES 22.0 OHM	1/4W 5.0%	R65	
05-119630	RES 300.0 OHM	1/4W 5.0%	R66	
05-119630	RES 300.0 OHM	1/4W 5.0%	R67	
05-115509	RES 22.0 OHM	1/4W 5.0%	R68	
05-119630	RES 300.0 OHM	1/4W 5.0%	R69	
05-114974	RES 3.9K	1/4W 5.0%	R70	

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FUNCTION GENERATOR 1981 - MODELS 420 A&C

PART NUMBER	DESCRIPTION		PRT REF	SPECIAL INFORMATION
05-119630	RES 300.0 OHM	1/4W 5.0%	R71	
05-114974	RES 2.9K	1/4W 5.0%	R72	
05-119634	RES 680.0 OHM	1/4W 5.0%	R73	
05-118420	RES 390.0 OHM	1/4W 5.0%	R74	M420C ONLY
05-115512	RES 18K	1/4W 5.0%	R75	M420C ONLY
06-112004	RES 62.0 OHM	1/2W 5.0%	R76	M420C ONLY
05-113998	RES 0.5 OHM	1.0W 1.0%	R77	M420C ONLY
05-113998	RES 0.5 OHM	1.0W 1.0%	R78	M420C ONLY
05-115509	RES 22.0 OHM	1/4W 5.0%	R79	M420C ONLY
05-118155	RES 1K	1/4W 5.0%	R80	M420C ONLY
05-118161	RES 10K	1/4W 5.0%	R81	M420C ONLY
05-118257	RES 5.6K	1/4W 5.0%	R82	M420C ONLY
05-118162	RES 15K	1/4W 5.0%	R83	M420C ONLY
06-110844	RES 510K	1/4W 5.0%	R84	
05-118256	RES 6.8K	1/4W 5.0%	R85	
06-111943	POT 5K	1/2W 10%	VR1	
05-119773	POT 5K	1/5W 20%	VR2	
05-118175	POT 100K	1/5W 20%	VR3	
05-119649	POT 1K	1/5W 20%	VR4	
05-119649	POT 1K	1/5W 20%	VR5	
05-119770	POT 100.0 OHM	1/5W 20%	VR6	
05-118175	POT 100K	1/5W 20%	VR7	
05-119649	POT 1K	1/5W 20%	VR8	
05-119649	POT 1K	1/5W 20%	VR9	
05-119773	POT 5K	1/5W 20%	VR10	
06-111943	POT 5K	1/2W 10%	VR11	
05-119779	POT 50K W/SWITCH	1/4W 30%	VR12	
05-118175	POT 100K	1/5W 20%	VR13	
05-116185	POT 1K	.1W 20%	VR14	M420C ONLY
05-119773	POT 5K	1/5W 20%	VR15	M420C ONLY
06-111369	CAP 3.0UF	100V	C1	
06-111948	CAP 0.33UF	100V	C2	
06-111947	CAP 0.033UF	100V	C3	
06-111946	CAP 3K PF	33V	C4	
05-116235	CAP 5.5-60PF	100V	C5	
06-111945	CAP 250.0PF	100V	C6	
05-117969	CAP 0.01UF	50V	C7	
05-117969	CAP 0.01UF	50V	C8	
01-119953	CAP 1K PF	1KV 20%	C9	

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FUNCTION GENERATOR 1991 - MODELS 420 A&B

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
06-111944	CAP 180.0PF 50V	C10	
05-112695	CAP 560.0PF 500V	C11	
05-117969	CAP .01UF 50V	C12	
05-118498	CAP 47.0UF 10V	C13	
05-119660	CAP .1UF 50V	C14	
06-111949	CAP 220.0UF 25V	C15	M420A ONLY
06-111949	CAP 220.0UF 25V	C16	M420A ONLY
06-111949	CAP 220.0UF 25V	C17	M420A ONLY
06-111949	CAP 220.0UF 25V	C18	
06-110774	CAP 22.0UF 16V	C19	
06-110774	CAP 22.0UF 16V	C20	
05-117969	CAP .01UF 50V	C21	
06-111944	CAP 180.0PF 50V	C22	
05-117969	CAP .01UF 50V	C23	
05-118498	CAP 47.0UF 10V	C24	
05-118084	CAP 2.2KUF 16V	C25	M420C ONLY
05-118426	CAP 10.0UF 25V	C26	M420C ONLY
05-117050	CAP 100.0UF 10V	C27	M420C ONLY
05-116188	CAP .022UF 100V	C29	M420C ONLY
05-111119	CAP 1K PF 1KV	C29	M420C ONLY
06-110306	CAP 10.0UF 20V	C30	M420C ONLY
06-110306	CAP 10.0UF 20V	C31	M420C ONLY
05-118498	CAP 47.0UF 10V	C32	M420C ONLY
05-112695	CAP 560.0PF 500V	C33	
06-111371	CAP .033UF 50V	C34	
05-115214	DIODE 1N4148 SIL	D1	
05-115214	DIODE 1N4148 SIL	D2	
05-115214	DIODE 1N4148 SIL	D3	
05-115214	DIODE 1N4148 SIL	D4	
05-115214	DIODE 1N4148 SIL	D5	
05-115214	DIODE 1N4148 SIL	D6	
05-115214	DIODE 1N4148 SIL	D7	
05-115214	DIODE 1N4148 SIL	D8	
05-115214	DIODE 1N4148 SIL	D9	
05-115214	DIODE 1N4148 SIL	D10	
05-113201	DIODE 1N4002 SIL	D11	M420A ONLY
05-113201	DIODE 1N4002 SIL	D12	M420A ONLY
05-113201	DIODE 1N4002 SIL	D13	M420A ONLY
05-113201	DIODE 1N4002 SIL	D14	M420A ONLY

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FUNCTION GENERATOR 1981 - MODELS 420 A&C

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
05-116206	DIODE MV5025 LED	D15	
05-115214	DIODE 1N4148 SIL	D16	
05-115214	DIODE 1N4148 SIL	D17	
05-113200	DIODE 1N4001 SIL	D18	M420C ONLY
05-113200	DIODE 1N4001 SIL	D19	M420C ONLY
05-113200	DIODE 1N4001 SIL	D20	M420C ONLY
05-112004	DIODE 1N914 SIL	D21	M420C ONLY
05-112004	DIODE 1N914 SIL	D22	M420C ONLY
06-111413	DIODE 1N5232B 5.6V ZENER	ZD1	
05-112634	DIODE 1N753A 6.2V ZENER	ZD2	M420C ONLY
05-115945	RECT BRIDGE 50V 1A W005		M420C ONLY
05-116458	TRANS 2N4126 SIL	Q1	
05-119216	TRANS 2N4338 FET	Q2	
05-117065	TRANS 2N5828 SIL	Q3	
05-116458	TRANS 2N4126 SIL	Q4	
05-117065	TRANS 2N5828 SIL	Q5	
05-116458	TRANS 2N4126 SIL	Q6	
05-117065	TRANS 2N5828 SIL	Q7	
05-117065	TRANS 2N5828 SIL	Q8	
05-115939	TRANS 2N4121 SIL	Q9	
05-117065	TRANS 2N5828 SIL	Q10	
05-115939	TRANS 2N4121 SIL	Q11	
05-117342	TRANS D40D1 SIL	Q13	M420C ONLY
05-115934	TRANS GET2222 SIL	Q14	M420C ONLY
05-115934	TRANS GET2222 SIL	Q15	M420C ONLY
05-117065	TRANS 2N5828 SIL	Q16	M420C ONLY
05-117065	TRANS 2N5828 SIL	Q17	M420C ONLY
05-119447	IC LM3046N	IC1	
05-117432	IC LM1458	IC2	M420A ONLY
05-119511	IC TL022	IC2	M420C ONLY
06-111950	IC LM319N	IC3	
05-118317	IC DM74C00N	IC4	
06-111110	IC 78L12A	IC5	
06-111951	IC 78L05A	IC6	M420A ONLY
05-117432	IC LM1458N	IC7	M420A ONLY
05-119511	IC TLC22	IC7	M420A ONLY
05-119447	IC LM3046N	IC8	
05-115928	IC LM741CN	IC9	M420C ONLY
06-111953	XFMR POWER	T1	M420A ONLY

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FUNCTION GENERATOR 1981 - MODELS 420 A&D

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
06-111961	LABEL ID & SPEC		M420D ONLY 120V
06-111962	LABEL ID & SPEC		M420D ONLY 220V
06-111963	LABEL ID & SPEC		M420D ONLY 240V
06-111956	LABEL XFMR		
10-863336	PC BD DC-DC CONVERTER		M420D ONLY
05-118916	LINE CORD		
10-864543	CASE ASSEM TOP BLUE		
03-320460	CASE BOTTOM BLUE		
05-118657	HEAT SINK		M420D ONLY
06-111960	BATTERY HOLDER		M420D ONLY
10-864544	PANEL ASSEMBLY		
05-118398	PLATE INSERT HANDLE		
01-117829	BUMPER RUBBER FOOT		
03-261059	COVER XFMR		
10-863216	BRACKET ASSEM POWER INPUT		
06-110113	BUTTON RED PUSH ON TYPE		
06-110114	BUTTON BLACK PUSH ON TYPE		
06-110115	BUTTON GRAY PUSH ON TYPE		
05-111622	CONNECTOR BNC		
05-117326	CONNECTOR JACK		
05-118140	KNOB BLACK 1/8IN BUSHING		
06-111941	KNOB BLACK 1/4IN BUSHING		
06-111977	KNOB FREQ INDICATOR		
05-117739	CLIP FUSE AG TYPE		
06-111955	BINDING POST METAL GROUNDING		
05-144572	SCREW 4-40 X 1/2		
05-181570	SCREW 4-40 X 1/4		M420D ONLY
01-182270	SCREW 6-32 X 5/16		
01-185659	SCREW 6-32 X 1/4		
01-401861	LOCKWASHER #4 INT. TOOTH		M420D ONLY
01-401862	LOCKWASHER #6 INT. TOOTH		
05-328427	SPACER HEX 1.75IN LG		
05-117161	SPACER HEX .625IN LG		M420D ONLY
01-181543	NUT HEX 3/8-32 X 3/32IN THK		
03-812201	NUT KNURLED 1/4-32X .062 THK	K	
05-117300	TERMINAL POST		M420D ONLY
06-112263	PLATE PANEL SUPPORT		
06-111534	TERMINAL GND SOLDER LUG		
06-111940	INSTRUCTION MANUAL		

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PHONE 697-2260

DIGITAL/OSCILLOSCOPE/SPECIAL PRODUCTS

FUNCTION GENERATOR 1981 - MODELS 420 A&D

PART NUMBER	DESCRIPTION	PRT REF	SPECIAL INFORMATION
01-401962	LOCKWASHER #6 INTERNAL TOOTH		
05-328427	SPACER HEX 1.75IN LG		
05-117161	SPACER HEX .625IN LG		M420C ONLY
01-181543	NUT 3/8-32 1/2 AF X 3/32		
03-812201	NUT KNURLED 1/4-32X .062 THK	K	
05-117300	TERMINAL POST		M420C ONLY
06-112263	PLATE PANEL SUPPORT		
06-111934	TERMINAL GND SOLDER LUG		
06-111940	INSTRUCTION MANUAL		

ITEM AVAILABLE FROM FACTORY DISTRIBUTION CENTER