INSTRUCTIONS

LOW FREQUENCY STANDARD

MODEL 100A

GENERAL DESCRIPTION

The Model 100A Low Frequency Standard consists of a 100 kc crystal-controlled oscillator, and a series of three 10 to 1 regenerative modulator type frequency dividers providing frequencies of 10 kc, 1 kc, and 100 cps. Output from each frequency is brought to separate terminals at the rear of the chassis through buffer stages having a low output impedance. Two output terminals are also provided on the front panel, together with a switch to select any one of the output frequencies desired. Output on all frequencies is essentially sinusoidal.

<u>100 kc Oscillator</u>: The 100 kc oscillator consists of a 100 kc crystal having a temperature coefficient of 2 cycles per megacycle per degree Centigrade, in a modified Colpitts circuit using a 6SJ7 oscillator tube. The crystal is in series with the tank inductance, the circuit oscillating under control of the crystal when the tank circuit is tuned approximately to the crystal frequency. Oscillations will be maintained over a fair range of the tuning capacitor, which is used to adjust the crystal to exactly 100 kc.

<u>Frequency Dividers</u>: The frequency of the 100 kc oscillator is divided in steps of 10 to 1, by means of three regenerative modulator type frequency dividers. The first divider steps the 100 kc down to 10 kc, the second divider steps the 10 kc down to 1 kc, and the third steps the 1 kc down to 100 cps. The action of all three dividers is alike, although the exact method of obtaining the result differs slightly in each. The fundamental action is as follows:

A frequency $\underline{f}$ is introduced into the first grid of a 6L7 modulator tube which has its plate circuit tuned to a frequency f/10. The plate circuit is also coupled to one of the grids of another 6L7 acting as a frequency multiplier, and having its plate circuit tuned to a frequency 9f/10. The plate circuit of the multiplier is in turn coupled back to the third grid of the modulator tube.

Assume a transient of some sort has started a small voltage of a frequency f/10 in the plate circuit of the modulator. This is multiplied by the multiplier tube to a frequency 9f/10, and fed to the third grid of the modulator where it mixes with the frequency $\underline{f}$ coming in on the first grid to give a frequency $\underline{f}$ - /10, or f/10, in the modulator plate circuit, increasing the f/10 voltage started out by the initial transient.

The action goes around the circuit again, the f/10 voltage soon building up to a stable maximum value. If the incoming frequency f is removed, the f/10 voltage will immediately stop, for there is nothing to mix with to maintain itself in operation.

In order to facilitate the multiplying action in certain cases, some of the frequency f is introduced in one of the other grids of the multiplier tube where a modulating action then takes place, similar to that in the modulator tube, the frequency f combining with the frequency f/10 to give a frequency f - f/10, or 9f/10, in its plate circuit.

Buffer Stages: Output from the 100 kc oscillator, and each of the dividers is taken from separate buffer stages consisting of 6AC7's triode connected, in a cathode load circuit. This provides a low output impedance, so that loads as low as 1000 ohms may be placed across the output without appreciably lowering the output voltage. The cathode load circuit also provides complete isolation of the different output frequencies.

Power Supply: The power source should be a 115 volt, 60 cycle supply line. The high voltage is obtained from an electronically-regulated rectifier supply so that the line voltage may vary from 105 to 125 volts without affecting the operation. Regulating the high voltage supply also provides a low audio impedance in the plate supply circuit, and aids in preventing interaction between the various output frequencies.

OPERATION

Initial Installation: When the instrument is first put into operation, the following procedure should be observed:

1. Make sure all tubes are firmly in their sockets, and that the grid clips are on all the 6L7 tubes.

2. Plug power cord into a 115 volt, 60 cycle power supply. It will take about 24 hours of heating for the crystal itself to come up to the proper operating temperature. At the end of that time, check the ratios between the various frequency dividers with an oscilloscope, as follows:

a. Connect the horizontal deflecting plates to the 10 kc binding posts, and the vertical deflecting plates to the 100 kc binding posts. A stationary pattern with 10 peaks across the top should be obtained. If this pattern is not stationary, or is blurred, adjust the tuning capacitor in the 10 kc divider until a clear, stationary 10 to 1 pattern is obtained. The capacitor should be left in the central position between the two points where the pattern ceases to be stationary. Each divider circuit is directly in line, front to rear, with its corresponding output terminals at the rear of the chassis.

b. Repeat the above procedure, using the 10 kc and the 1 kc output, and the tuning capacitor on the 1 kc divider.

c. Repeat, using the 1 kc and 100 cps output, and the tap-switch capacitor adjustment for the 100 cps divider.

Output voltages from all frequencies should be 5 volts or better on open circuit after above adjustments. The instrument is now ready for operation.

Output from any of the output frequencies may be obtained separately from the marked binding posts at the rear of the chassis, or if desired, any of the frequencies may be obtained from the binding posts on the front panel by setting the selector switch to the desired frequency. Output at all frequencies is practically sinusoidal, so that frequencies may be used for frequency determination by means of Lissajou's figures up to quite high and complex ratios.

Leading the output with less than 1000 ohms load will lower the output voltage considerably, and will also cause some distortion which might be objectionable for use with high multiple or complex patterns. If harmonics of the output are desired, see page 4 for complete instructions.

Adjustment of 100 kc Oscillator Frequency: The frequency of the 100 kc oscillator has been set at the factory to within a cycle or two of 100 kc at the existing room temperature. A variation of ±33°C will cause only a ±0.0066% change in frequency.

MAINTENANCE

After the initial adjustments have been made, no further adjustment should be required, except for occasional blowing out of the unit, and a check on the condition of the tubes.

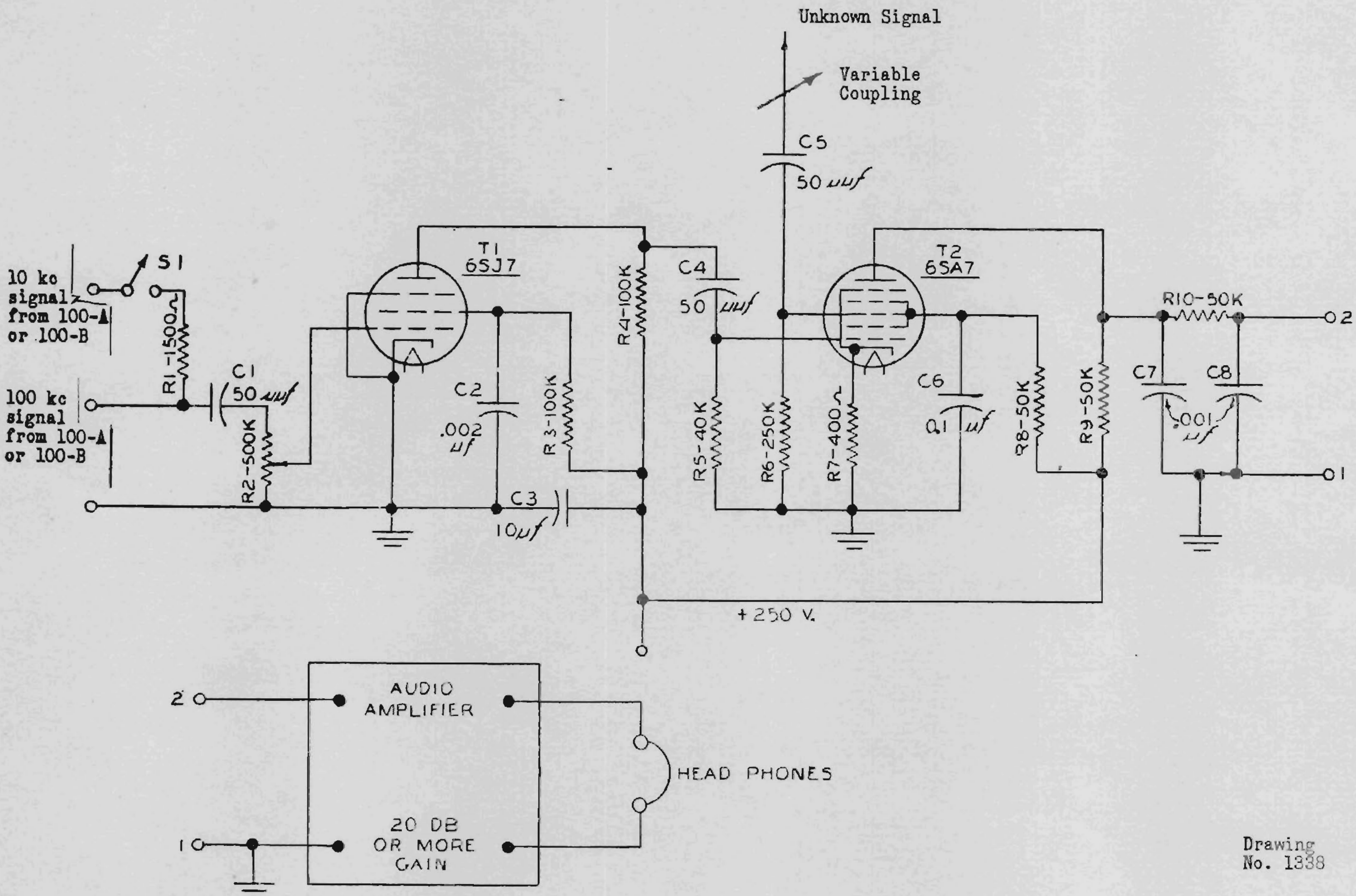
The fan should be cleaned and oiled every thirty days.

One check it is well to make periodically is that of the frequency ratio of the dividers, as explained in the operating section, under initial adjustments. Those dividers should remain in operation indefinitely without change, but extreme temperature changes or aging of the tubes, etc., may cause them to become de-tuned, and be off frequency, so that an occasional check is a safety precaution.

MIXER CIRCUIT

for use with the
-hp- 100-A or 100-B Low Frequency Standard.

Will supply 10 kc harmonics
up to 20 mc



Drawing
No. 1338

The above circuit will, when operated with a Model 100-A or 100-B, provide a method of frequency calibration up to 20 mc. With care, this mixer is usable up to 30 mc. The strength of the unknown and standard signals should be adjusted to give just a satisfactory signal in the headphones. Very strong signals will result in beats between sub-harmonics, obscuring the wanted check points.

In general, it is best to locate the 100 kc points first (with only a 100 kc signal in the mixer). Once these points are located on the interpolation device, the 10 kc signal is injected by closing switch S1. With this condition, both the 10 kc points and the 100 kc points can be located and employed for frequency measurement.

HEWLETT-PACKARD COMPANY
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CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number, type number and serial number when referring to this instrument for any reason.

WARRANTY

Hewlett-Packard Company warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof (except tubes, fuses and batteries). This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and which upon our examination is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number, type number and serial number. On receipt of this information, we will give you service instructions or shipping data.

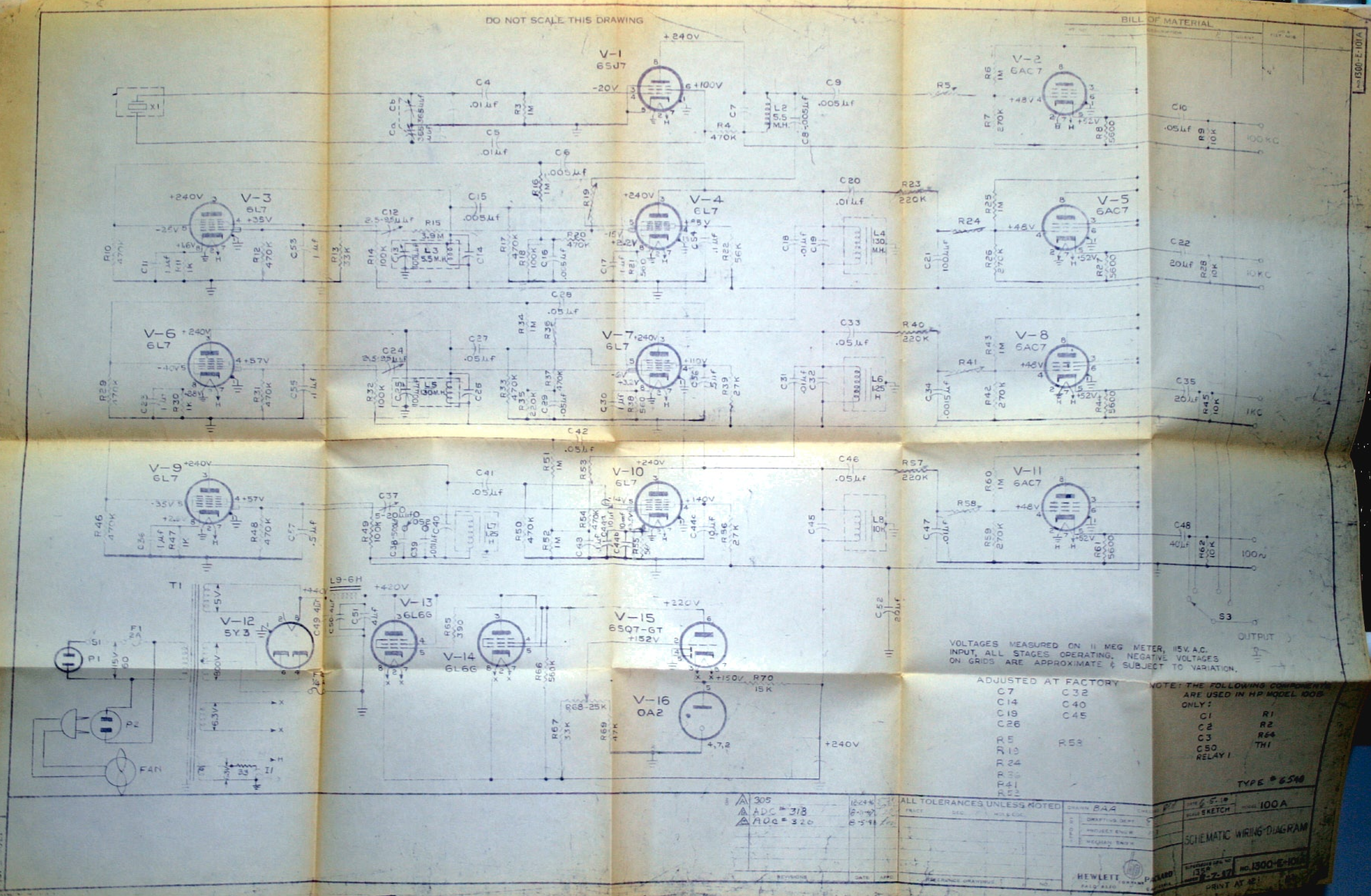
2. On receipt of shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

SHIPPING

All shipments of Hewlett-Packard instruments should be made via Railway Express. The instruments should be packed in a wooden box and surrounded by two to three inches of excelsior or similar shock-absorbing material.

DO NOT HESITATE TO CALL ON US

HEWLETT-PACKARD COMPANY
Laboratory Instruments for Speed and Accuracy
395 PAGE MILL ROAD PALO ALTO, CALIF.


DO NOT SCALE THIS DRAWING
BILL OF MATERIAL
V-1 6SJ7
V-2 6AC7
V-3 6L7
V-4 6L7
V-5 6AC7
V-6 6L7
V-7 6L7
V-8 6AC7
V-9 6L7
V-10 6L7
V-11 6AC7
V-12 5Y3
V-13 6L6G
V-14 6L6G
V-15 6SQ7-GT
V-16 OA2
100 KC
10 KC
1 KC
100~
S3
OUTPUT
VOLTAGES MEASURED ON 11 MEG METER, 115V. A.C. INPUT, ALL STAGES OPERATING. NEGATIVE VOLTAGES ON GRIDS ARE APPROXIMATE & SUBJECT TO VARIATION.
ADJUSTED AT FACTORY
C7 C32
C14 C40
C19 C45
C26
R5 R59
R19
R24
R36
R41
R52
NOTE: THE FOLLOWING COMPONENTS ARE USED IN HP MODEL 100B ONLY:
C1 R1
C2 R2
C3 R64
C50 TH1
RELAY 1
TYPE # 6540
ALL TOLERANCES UNLESS NOTED
305
ADC # 318
ADC # 320
DRAWN BAA
SKETCH
100A
SCHEMATIC WIRING DIAGRAM
HEWLETT PACKARD
NO. 1300-E-101A
PRINT AT 12