FERRIS INSTRUMENT COMPANY
Boonton, N. J.
MADE IN U. S. A.

OPERATING INSTRUCTIONS

for

MODEL 18C and 18D MICROVOLTER

per new letter 12/12/56 O(R) Supplies Catalog

CAUTION:

The Model 18C and 18D Microvolter is designed for operation from an A.C. power source. The voltage and frequency of the power supply is engraved upon a voltage name-plate fastened to the instrument case below the power connecting cord. NEVER attempt to operate from a D.C. supply.

TO PLACE INSTRUMENT IN SERVICE:

Domestic shipment of the Model 18C and 18D Microvolter is made with all tubes in their places within the instrument.

For export shipment all tubes are usually removed and separately packed. Upon receipt the back should be removed from the microvolter and the tubes inserted in their proper sockets and the back replaced. Be sure that the 955 tube marked "R.F. Oscillator" is placed in the proper socket, as the calibration of the instrument depends upon this tube.

GENERAL OPERATION:

Plug the power cord into the designated line voltage and operate the power switch to "ON". After allowing about one minute for the tubes to warm up, turn the R.F. voltage control as far to the left as it will go, which removes all the plate voltage from the oscillator and reduces its output to zero. Then the R.F. voltage meter should be set to zero by means of the screw-driver control marked "O ADJ."

Set the coil knob to the desired frequency range, and the tuning dial to frequency required, as shown on the calibration chart. With the R.F. meter at 1.0, the output in microvolts equals the reading of the microvolts dial times the attenuator knob setting. If a higher output is desired, it can be obtained from the high-output jack by removing the cover and plugging in with the plug shipped with the instrument. The voltage obtained from the jack is about .7 volt, but it will vary with frequency, length of leads, etc. When not in use this jack should be kept covered to avoid leakage or stray-field from it.

NOTE:

The first line on the scale of the output potentiometer (Microvolts) is not marked "O" in the usual manner. With the type of construction used for the potentiometer in the 18C and 18D, it is not possible to reduce the output voltage to zero at this point; there will always be a residual output of the order of 0.1 microvolt. The line is placed on the scale for mechanical zero-setting purposes only and should not be used in normal operation.

CONNECTIONS:

In connecting the output terminals to the receiver under test, the greatest care must be exercised to use the shortest possible connecting leads. A very few inches of connecting wire may make a great difference in the results obtained, errors of several hundred per cent frequently being found with leads of the order of six to twelve inches long, particularly when working into a reactive load, such as a tube grid. It is preferable, if possible, to eliminate the ground lead entirely by clamping the output binding post marked "GND" directly to some part of the receiver shielding structure, and then using the shortest possible lead from the high-potential (unmarked) output terminal to the tube grid or other point at which the microvolter output voltage is to be applied.

The Model 18C and 18D Microvolter has been designed so that output voltage appears at a terminal box attached to a flexible cable. This makes it possible to apply the testing voltage directly to the point under test, thus avoiding errors due to resonant effects that occur in long leads. The cable is terminated by a 30 ohm resistor. Care should be taken when using the generator, to see that external loads connected to the output terminals are not of such values as to shunt this resistance to any great extent. At higher frequencies the reactances of even rather small capacitances becomes quite low, and the user should calculate the reactances of such loads to be certain that they are not comparable with the generator output impedance. Furthermore, the effect of the 30 ohms must be taken into account whenever the generator output is connected into a dummy antenna circuit, and the dummy antenna resistance corrected to compensate for the generator resistance.

A special compensating circuit is used with the vacuum-tube voltmeter. This circuit is designed to correct for the frequency error of the output system. This is accomplished by adjustments at the factory of the trimmer condenser located in the silver ribbon inductive potentiometer compartment; since any readjustment of this condenser will seriously affect output voltages, this should not be disturbed.

MODULATION:

With the modulation switch in the "EXT" position, external modulation may be applied to the "EXT MOD" jack by removing the cover and plugging in with the plug which is shipped with the instrument.

Thirty per cent modulation is secured with an audio input of approximately 37 volts R.M.S. When not in use this jack should be kept covered to avoid leakage or stray fields from it.

With the switch in the "OFF" position, the carrier is unmodulated.

Turning the switch to the 400 or 1000 cycle position, the carrier is modulated 30% by means of the internal audio oscillator. The percentage modulation of these internal audio frequencies may be adjusted by means of the two screw-driver adjustments on the rear of the power supply unit. Referring to the rear view sketch FYB-1, the 400 cycle adjustment is below tube 19, and the 1000 cycle adjustment is to the left of the 400 cycle adjustment.

LINE FILTER:

Due to the filter condensers from each side of the AC line to the case, a small spark may be noticed when a grounded lead is connected to the case or to the ground terminal; or a shock may be felt if the case, while ungrounded, is touched at the same time as a grounded object. It is usually advisable to ground the microvolter case to avoid the possiblity of shocks as mentioned.

A more detailed description of the effects due to the presence of the filter condensers will be found in Instruction Sheet FYB-2, Notes on the Use of AC Operated Microvolters," which should be consulted before attempting to measure AC-DC types of receivers, as special precautions are necessary in such cases.

TUBES:

Six tubes, all of standard characteristics, are used. They are:

1—Type 5Y3GT Rectifier
1—Type 6L5G Audio Oscillator
1—Type 955 Radio Frequency Oscillator
1—Type 955 Output R.F. Voltmeter
2—Type VR90 Voltage Regulators

The R.F. oscillator tube is reached by removing the copper shield cover of the R.F. oscillator unit; the R.F. voltmeter tube can be reached by removing the shield cover over the silver ribbon inductive potentiometer unit, which is located directly under the R.F. oscillator unit. All covers must be carefully replaced and the screws which fasten them in place drawn up tightly after any inspections or tube replacements. Also, the back cover of the outer case must be well fastened if external leakage from the generator is to be avoided.

MAINTENANCE:

The design of this microvolter is much more critical and dependent upon the exact placement of parts than is the case with instruments intended for lower frequencies. It is to be strongly emphasized that in the event that any parts are removed for inspection or replacement, they must be replaced in exactly the same positions, and all wiring must be replaced exactly as found. Neglect of this precaution may result in output voltage errors of many hundred per cent or, perhaps, the setting up of leakage fields so great as to make the instrument unusable. The following paragraphs contain suggestions for tests which the user may make in order to determine whether or not the instrument is working properly.

LOW METER READING:

First determine if the zero of the meter is properly set as described under GENERAL OPERATION. With the zero properly set, ample output should be obtained on all coils. If this is not obtained, a likely source of trouble is aging of the oscillator tube, try replacing it with a new tube. If a new tube is not available, the instrument can be operated at a value lower than 1.0, such as 0.5, in which case the output values should be multiplied by 0.5. Low output may also be due to dirty contacts on the coil drum. These should be cleaned and lubricated with vaseline.

CAN'T SET METER ZERO:

With the R.F. voltage control set all the way to the left, or the coil switch set between points, the meter should read zero. This meter is a diode type of vacuum-tube voltmeter and the "O ADJ" screw controls the biasing voltage for balancing out the initial current. The meter reading higher than zero indicates a failure of this biasing voltage, due to an open resistor or connection, or possible failure of entire B+ supply. The meter reading below indicates excessive biasing voltage, perhaps due to failure of the biasing potentiometer. Look for defective contact. This condition may be due also to a bad voltmeter tube. See if the tube is operating, look for the glow of the heater.

DISCREPANCIES IN OUTPUT VOLTAGE:

This may be due to defective resistors in the step attenuator. The operation of this attenuator can be checked as follows: Connect, through the usual dummy antenna, to a receiver in which the automatic volume control has been replaced by a manual control. Set the microvolter for 10 microvolts output (output dial at 10, switch at MULTIPLY BY 1), tune the receiver and adjust the volume control to give a suitable output as shown on an output meter connected to the receiver. Then turn the output dial of the microvolter to zero, set the switch on MULTIPLY BY 10, and increase the output dial setting until the same output

is obtained as before. Reset output meter to 1.0 and re-tune when necessary. The dial should, of course, read 1.0 (since this would give 10 microvolts indicated output as before). Similar checks can be made between other attenuator ranges at 10, 100 and 1000 microvolts, by reducing the receiver sensitivity. These tests check the attenuation of each successive step in the attenuator. Of course, the receiver gain must be steady during this test and, if line voltage or anything else varies, the test should be repeated.

OTHER TROUBLES:

The above paragraphs describe the troubles most likely to occur. The schematic diagram furnished shows values of components of the circuit which should be helpful in locating other troubles, should they occur. The voltage of the B+ terminal should be 170 V.-180 V.; the VR90 tube regulates the voltage to this value for greater stability in operation. Heater voltages are about 6.3 V. AC. The modulation voltage at the B+ terminal should be about 37 V. R.M.S. when read with a high impedance AC voltmeter. This meter should have provision for stopping DC currents, so that it will read AC voltage only.

The percentage modulation may be adjusted by means of the two screw-driver adjustments on the rear of the power modulator chassis. This adjustment should preferably be made at 5 megacycles.

ADDITIONAL INFORMATION:

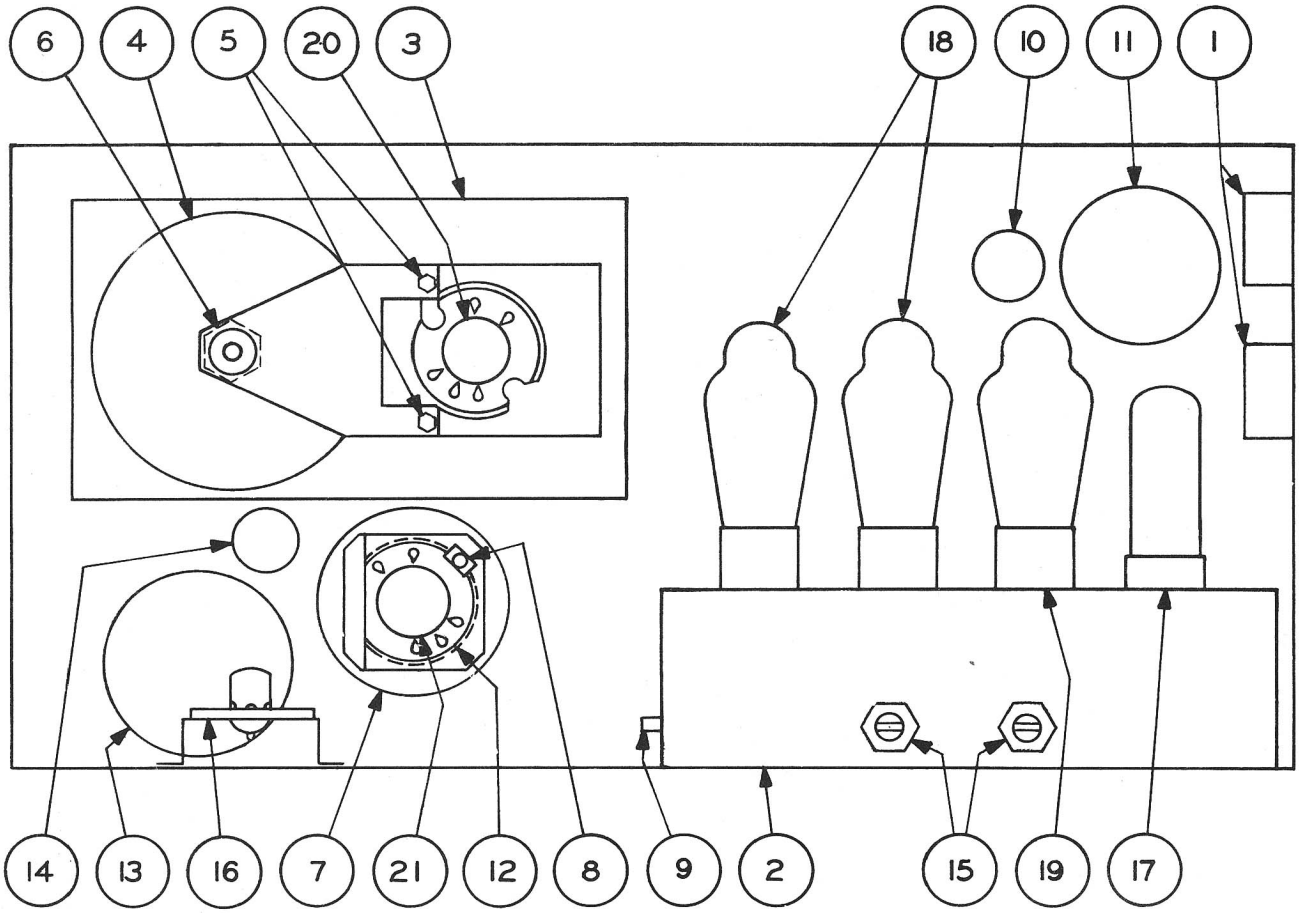
If any difficulty is experienced in the operation of the microvolter which cannot be located from the information in this Instruction Book, please write to Ferris Instrument Company, Boonton, N. J., giving the serial number of the Microvolter and describing the difficulty experienced in as much detail as possible.

FERRIS INSTRUMENT COMPANY

Boonton, N. J.

U.S.A.

REAR VIEW OF 18C & 18D MICROVOLTER



1- FAQ-1, LINE FILTER
2- FAP-45, AUDIO OSCILLATOR, MODULATOR & POWER SUPPLY
3- FAO-1, R.F. OSCILLATOR
4- FAO-2, R.F. COIL ASSEMBLY
5- FQT-6, BRACKET NUT
6- FQP-2, COIL DRUM BEARING NUT
7- FAH-1, V.T.V.M. CALIBRATED INDUCTIVE POTENTIOMETER ASSY.
8- CT-11, V.T.V.M. ADJUSTING CONDENSER
9- RV-42, V.T.V.M. SENSITIVITY CONTROL
10- RV-45, V.T.V.M. ELECTRICAL ZERO ADJUSTMENT
11- BM-13, V.T.V.M. INDICATING METER
12- FAH-4, CALIBRATED INDUCTIVE POTENTIOMETER
13- FAA-5, STEP ATTENUATOR
14- HK-34, HIGH OUTPUT SOCKET
15- RV-51, PER CENT MODULATION CONTROLS
16- SOCKET FOR SPARE TUBE (FURNISHED ON SPECIAL ORDERS)
17- 5Y3GT RECTIFIER TUBE
18- VR-90, VOLTAGE REGULATOR TUBE (2 REQUIRED)
19- 6L5G AUDIO OSCILLATOR TUBE
20- 955, R.F. OSCILLATOR TUBE
21- 955, V.T.V.M. TUBE

FYB-1-F

NOTES ON THE USE OF A.C. OPERATED MICROVOLTERS AND SIGNAL GENERATORS

Microvolters and Signal Generators are frequently damaged through carelessness in their use.

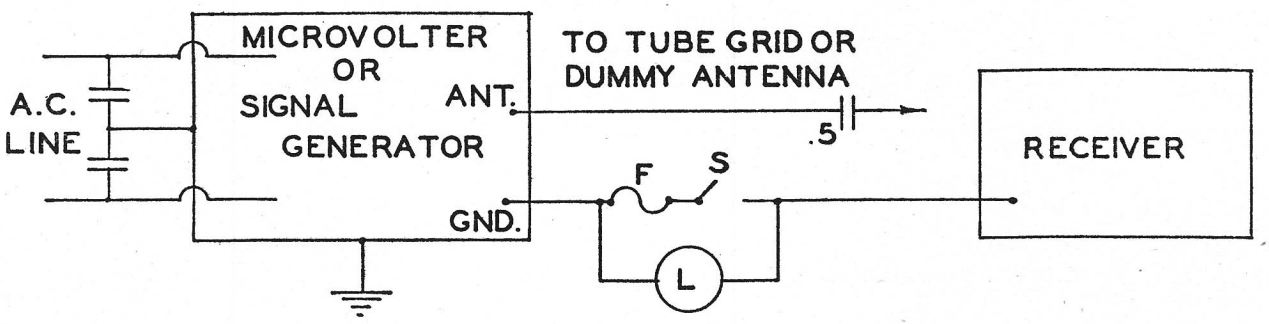
AC operated instruments should never be connected to a DC source of power.

The case should be grounded to avoid shocks to the operator. If this is not done the case will be above ground potential due to the filter condensers connected across the power line as shown in the figure.

The output of the attenuator should never be connected to a voltage source, AC or DC, high enough to damage the attenuator resistors (not over 3-4 V.) Trouble is most likely to be encountered in testing AC-DC receivers.

To avoid trouble when testing AC-DC receivers .5 mfd. condensers can be used in the antenna and ground connections between generator and receiver. This has a negligible effect on radio frequency but serves to block any direct or low frequency current. If severe hum is heard it is probable that the ungrounded side of the power line is connected to the receiver chassis and the receiver line plug should be reversed to correct this.

In some few cases, especially when it is necessary to connect the output of the microvolter to a tube grid instead of to the antenna lead of the receiver, some hum will still be left. The only satisfactory remedy in this case is a direct connection between the grounded Microvolter case and the receiver chassis with proper safe guards as shown in the figure.



F is a small fuse, preferably 1/8 ampere size.

L is a 110 volt electric light bulb, preferably about 40 watt.

S is a small switch.

When connections are made as above plug the receiver into the line with the plug in one direction then in the other while the switch **S** is **OPEN**. With the plug in one way the lamp will light showing that the "hot" or ungrounded side of the line is connected to the receiver chassis. Do not leave the plug in this position but reverse it so that the lamp does not light. This shows that the grounded side of the line is connected to the receiver chassis and the Switch **S** can then be closed and measurements made.

FERRIS INSTRUMENT COMPANY
Boonton, N. J.
U.S.A.

SCHEMATIC NO.	OUR PART NO.	DESCRIPTION
C 1	CV-19	50 mmfd. Variable
C 2	CM-34	25 mmfd.
C 3,22,23	CM-41	300 mmfd.
C 4	CM-45	.002 mfd.
C 5,7,9,10	FACM-1	400 mmfd.
C 6,11,12	CM-55	300 mmfd.
C 8,15,16, 17,18,24, 26	CH-26	.1 mfd.
C 13,14,19, 20,25	CH-1	.01 mfd.
C 21	CT-11	4 mmfd. Variable
C 27,28	CH-48	8 mfd. Paper
C 29	CH-38	.04 mfd.
C 30	CH-27	.25 mfd.
C 31	CH-39	1 mfd.
R 1	RC-44	20,000 ohm
R 2,11,20	RC-26	500 ohm
R 3	RV-52	25,000 ohm Pot
R 4		50-100 ohm
R 5	RV-45	200 ohm Pot
R 6	RC-48	40,000 ohm
R 7	RC-40	7,500 ohm
R 8	RV-42	5,000 ohm Pot
R 9	RC-42	35,000 ohm
R 10	RW-114	3,500 ohm
R 12,13	RV-51	2,500 ohm Pot
R 14	RC-31	1500 ohm
R 15	RC-10	150 ohm
R 16	RC-134	100 ohm
R 17	RC-114	200 ohm
R 18	FRC-178	100 ohm
R 19	FRC-179	43 ohm
R 21,29	RC-5	30 ohm
R 22,23,24	RC-6	33 ohm
R 25,26,27, 28	RC-11	270 ohm
L 1		R.F. Oscillator Coils
L 2,4,5	FLR-15	R.F. Choke Coil
L 3	FAH-4	Silver Ribbon Inductive Potentiometer
L 6,7,8,9	LC-4	Choke Coils
T 1	LP-21	Power Transformer
T 2	LC-3	Choke
T 3	LC-8	Choke
T 4	FLA-5	Audio Oscillator Transformer

FERRIS INSTRUMENT CORPORATION
Boonton, N. J.

No. FYS-2-I

SCHEMATIC NO.	OUR PART NO.	DESCRIPTION
M 1	BM-13	R.F. Voltage Meter
J 1	HK-34	High Output Jack
J 2	HK-34	Ext. Mod. Jack
SW 1	HQ-8	On-Off Switch
SW 2	HR-38	Modulation Switch

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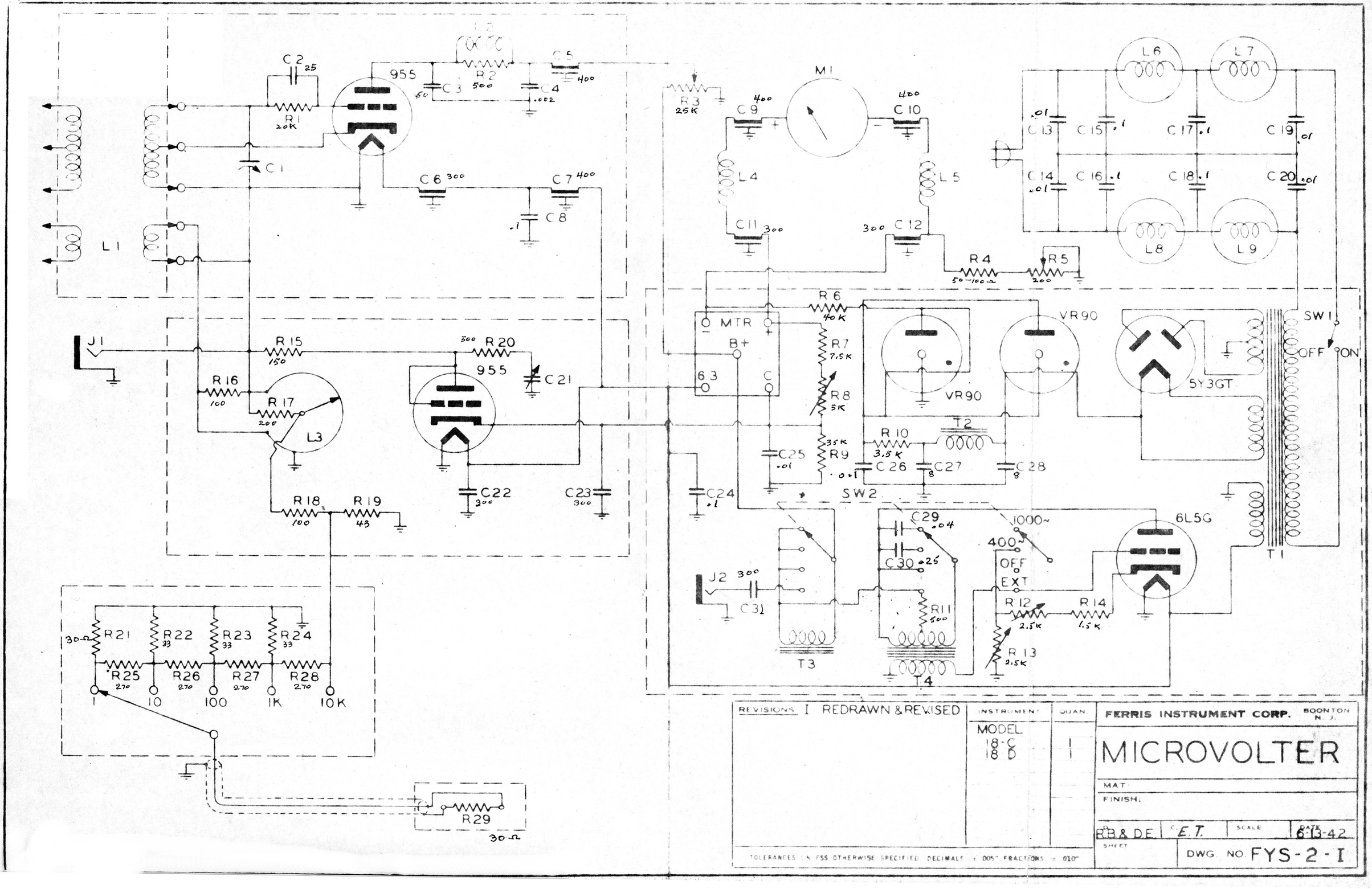
No. FYS-2-1



REVISIONS I REDRAWN & REVISED	INSTRUMENT: MODEL 18-C 18-D	QUAN. 1	FERRIS INSTRUMENT CORP. BOONTON N. J.
			MICROVOLTER
			MAT.
			FINISH:
TOLERANCES UNLESS OTHERWISE SPECIFIED: DECIMALS ± .005" FRACTIONS ± .010"			R.B. & D.E. E.T. SCALE 6-13-42 SHEET DWG. NO. FYS-2-I