WILCOM T136B

OPERATION MANUAL

MODEL T136B

CIRCUIT TEST SET

1.0 GENERAL DESCRIPTION

The Model T136B is a portable, compact, combination level and noise measuring set designed to facilitate making circuit and noise measurements by installers and repairmen without using elaborate or expensive equipment. It has three ranges of measurement which are calibrated for the normally acceptable limits of circuit loss, noise metallic and noise to ground; loop current may also be measured on a scale calibrated in DC milliamps from 0 to 100.

Transmission measurements are made with flat weighting, which has a flat frequency response from 300 Hz to 15 kHz; the response at 60 Hz is attenuated approximately 27 dB. Noise measurements are made with C-Message weighting. The input impedance for CKT LOSS and CKT NOISE measurements is 735 ohms which is the geometric mean of 600 and 900 ohms.

The term CKT NOISE (Circuit Noise) is the same as Noise Metallic used in noise measurement work. PWR INFL (Power Influence) is the same as Noise-to-Ground.

A dialing and holding arrangement makes it possible to dial a remote test line when the FUNCTION switch is in the DIAL & LINE MA position, and to hold the connection in all measurement positions of the FUNCTION switch. Square posts are provided for connecting a dial telephone hand set to the set. The hold coil provides a DC resistance of about 175 ohms with AC impedance high enough to have no significant effect on the measurements.

The DC line current may be measured when the FUNCTION switch is in the DIAL & LINE MA position. The meter includes a scale calibrated from 0 to 100 Ma in 5 Ma increments.

Three measuring ranges are provided on the FUNCTION switch. The first of these positions is called CKT LOSS and provides means for measuring, on a terminated basis, the level of a tone received from a 1 mw reference tone source, over a level range of approximately -15 dBm to +3 dBm on a color segmented meter scale. Measurements may be made at frequencies other than 1 kHz as the CKT LOSS response characteristic is flat from 300 Hz to 15 kHz; 60 Hz is attenuated more than 27 dB.

The next position of the FUNCTION switch is designated CKT NOISE which provides additional sensitivity for measuring noise metallic on a C-Message weighted basis. The color segmented meter scale for this measurement extends from approximately 33 dBrnc to 15 dBrnc.

The third measuring position of the FUNCTION switch designated as PWR INFL, (Power Influence), provides means for measuring noise voltages between a circuit and ground on a C-Message weighted basis. The input circuit in this position has an impedance of about 200,000 ohms between the input terminals and over 100,000 ohms between

either input terminal and ground. The noise to ground level is measured on the same color segmented scale as CKT NOISE but the range of measured noise is now arranged for the normal range of Power Influence measurements; the scale extends from 93 dBrnc to 75 dBrnc.

In most conventional noise measuring sets, 40 dB is added to the noise to ground measurements to take into account the difference between noise metallic and noise to ground measurement reference voltages; the sum gives the absolute level of noise to ground measurements. The PWR INFL scale on the meter is calibrated to provide the absolute value, so it is not necessary to add 40 dB to the measurement.

A non-locking push button switch is provided to add 20 dB attenuation of the input signal if the signal level is high enough to cause the meter to read off scale. In most cases, operation of the switch will bring the meter pointer back on scale. Consequently, the T136B has a range of measurement of about 35 dB.

A phone jack is provided to enable the tester to listen to the signals being measured without interfering with the measurements.

Three 4 ft. long leads equipped with clips and colored green for tip, red for ring, and yellow for ground are permanently attached to the set.

A non-locking push button switch is used to supply power to the measuring circuits from two small 9 volt batteries. No current is supplied by the batteries until the switch is depressed to take a reading. Consequently, the useful like of the batteries can approach shelf life because the ON period is usually very short.

2.0 PERFORMANCE SPECIFICATIONS

MEASURING RANGES

	METER SCALE	LEVEL RANGE
CKT LOSS	Red	above 0 dBm
	Green	0 to -10 dBm
	Red	below -10 dBm
CKT NOISE (Noise Metallic)	Red	30 to 33 dBrnc
	Yellow	20 to 30 dBrnc
	Green	below 20 dBrnc
PWR INFL (Noise to Gnd)	Red	90 to 93 dBrnc
	Yellow	80 to 90 dBrnc
	Green	below 80 dBrnc
MA	Orange	0 to 100 MA

FREQUENCY RESPONSE

Flat from 300 Hz to 15 kHz for CKT LOSS measurements; 60 Hz attenuated more than 27 dB. (See Fig. 4)

C-Message Weighting for Noise Measurements (See Fig. 5)

INPUT IMPEDANCE

CKT LOSS and CKT NOISE: 735 ohms

PWR INFL: Approximately 200,000 ohms between the input terminals and approximately 100,000 ohms between either input terminal and ground.

HOLD CIRCUIT

Resistance: 175 ohms

AC Impedance: Has no effect on measurements with 80 ma DC in coil.

CONTROLS, TERMINALS, JACK

Function Switch

ADD 20 dB Pushbutton Switch

PUSH TO MEAS Pushbutton Switch (Power)

Phone Jack

DIAL Terminals

CONNECTING LEADS

Three 4 ft. leads with clips and colored Green for Tip, Red for Ring, and Yellow for Ground.

BATTERIES

Two 9 volt batteries. Eveready No. 216 or equivalent (NEDA No. 1604).

SIZE

4 3/8" W x 6 3/8" L x 4 7/8" H

WEIGHT

3 lbs.

3.0 CIRCUIT DESCRIPTION

3.1 General

3.1.1 The complete circuit can be subdivided into 4 sections, as follows:

1. Input and meter section.
2. Circuit loss filter section.
3. Circuit noise and power influence section.
4. Quasi-rms detector section.

3.1.2 Each subsection will be described separately. Refer to the Schematic Diagram, Fig. 3 and the Parts Layout Drawing, Fig. 7

as required.

3.2 The Input Section

3.2.1 The function of the input section is to normalize the signal levels received in various modes of operation, to a single set of values; to provide isolation and impedance matching; to convert from a balanced line to an unbalanced line.

3.2.2 With the FUNCTION switch S1 in the DIAL & LINE MA position, the T lead (+ line) thru sections C2 and B1 of switch S1 is connected to the + terminal of the meter thru a series resistor, R12. The - terminal, thru section A1 of switch S1 is connected to a DIAL post. The R lead (- line), thru section B2 of switch S1, is connected to the other DIAL post.

3.2.3 The meter circuit is shunted by R10 (actually 2 resistors) which are the current calibration resistors.

3.2.4 If a telephone set is connected to the DIAL posts, and the T & R leads attached to a telephone circuit, the meter will read the loop current through the series circuit as described. It is not necessary to depress the "push to meas" switch for this function.

3.2.5 With The FUNCTION switch in either the CKT LOSS or the CKT NOISE position, the T & R leads are connected thru a pair of DC blocking capacitors to the isolation transformer T1 primary winding. A 4 Henry inductor, L1, is also connected across the T & R leads to provide a DC hold circuit of up to 80 MA.

3.2.6 One side of the secondary of T1 is grounded thru resistor R4 which forms part of a 40 dB attenuator used in the PWR INFL position. The other side of the secondary is connected to the 20 dB attenuator Ckt R5, R6, R7, and push button switch S2. The attenuator output is applied directly to the inputs of both the circuit loss bandpass filter section and the C message filter section.

3.2.7 With the FUNCTION switch in the PWR INFL position, the T & R leads are connected together through R1 & R2 in series. The junction of R1 and R2 is connected through DC blocking capacitor C3 to the junction of R4 and the secondary of T1. Thus any longitudinal signal voltage on the pair under test is attenuated 40 dB and appears across R4 and, thru the secondary of T1, to the 20 dB attenuator and to the C message filter input. The inductor L1 remains across the T & R leads.

3.2.8 With the FUNCTION switch in the BATT TEST position, and the PUSH to MEAS switch, S3, depressed, the $\pm$ 9V from the 2 batteries thru transistors Q1 and Q2 is applied across the meter thru R11 and R15, thru switch decks A1 and B1, and resistor R12. L1 is removed from the T & R leads in this position.

3.3 The Circuit Loss Section

3.3.1 The normalized signal voltage to be measured is applied to capacitor C5 as previously described. C5, C6, R8, R9, and IC1 form an active bandpass filter whose characteristic curve is given in Fig. 4.

3.3.2 The weighted signal is then coupled through DC blocking capacitor C7, Circuit Loss calibration pot R13, Resistor R14 and switch deck C1 to the quasi-rms detector input. Resistor R14 is changed from 150K in the "B" model to 47K in the "BC" model. This change provides the 10 dB extra gain required to read -10 dBm at what is normally the 0 dBm point on the meter.

3.4 The circuit Noise and Power Influence section

3.4.1 The normalized signal voltage to be measured is applied to capacitor C9 as previously described.

3.4.2 This section is a C message filter divided into 2 parts; an active type high pass filter, consisting of C9, C10, C12, C13, R16, R17, R18, R19, and IC2. This filter shapes the low frequency end of the Fig. 5 characteristic curve.

3.4.3 The other half is a passive type low pass filter consisting of C17, C18, C19, L2, L3, R23 and R24. This filter shapes the high frequency end of Fig. 5. R23 & R24 are impedance terminations.

3.4.4 IC3 and its associated components provide gain sufficient to make up for the filters' insertion loss. R22 is the CKT NOISE calibration control. C16 is a DC blocking capacitor.

3.4.5 The signal from R24 is applied to the detector thru deck C1 of the FUNCTION switch, S1.

3.5 The Quasi-rms Detector section

3.5.1 IC4 & IC5 and associated components comprise the quasi-rms detector. This type of detector is used rather than an average responding type so that accurate measurements may be made with signal waveforms whose shape departs radically from that of a sine wave, such as rectangular waves and "white" noise.

3.5.2 IC4 is basically an amplifier. The diodes D1 & D2 provide a step function at 0 volts crossover to compensate for the drop of diodes D3 & D4. IC5, R27, & R28 with D3 & D4 are a unity gain, full wave rectifier whose output is applied to the meter circuit through R35 and switch S1 deck B1.

3.5.3 The quasi-rms characteristic is obtained by the ratio of R35 and the meter circuit resistance which includes the meter + R12, along with capacitor C8. The amount of capacitance is not critical above a certain minimum value.

3.5.4 It is interesting to note that without R35, the circuit becomes a peak detector; with R35 but without C8, the circuit becomes an average responding detector.

3.6 Miscellaneous

3.6.1 Power switching is done by a pushbutton switch which, when depressed, allows current to flow from + battery through the E-B junction of Q1, R32, the N.O. contacts of S3, R33, and the E-B junction of Q2 to - battery, driving Q1 & Q2 into saturation. This method of

power control assures simultaneous application of both + and - voltages to the set.

3.6.2 The monitor jack output is taken from the output of IC4. Any impedance headset may be used without affecting the set performance, but very low or very high impedance earphones generally will not have enough volume. 600 ohms is a good nominal impedance.

3.7 Reference Voltages

3.7.1 RMS voltages at 1 KHZ which will make the meter read at the 90 mark (3 dB below full scale) are as follows:

3.7.2 CIRCUIT LOSS MODE

At input T & R leads = 0 dBm
At C5-R7 junction = 845.0 millivolts
At R26-R30 junction = 1.0 Volt

3.7.3 CIRCUIT NOISE MODE

At input T & R leads = -60 dBm
At C5-R7 junction = 0.845 millivolts
At C16-R20 junction = 34.0 millivolts
At R26-R30 junction = 1.0 Volt

3.7.4 POWER INFLUENCE MODE

At input T & R leads = 775.0 millivolts
At C3-R9 junction = 0.935 millivolts
At C5-R7 junction = 0.845 millivolts
At C16-R20 junction = 34.0 millivolts
At R26-R30 junction = 1.0 Volt

4.0 OPERATION

4.1 Connections

4.1.1 Connections to the circuit to be tested are made with the clip leads on the end of the red, green, and yellow leads which represent ring, tip and ground respectively.

4.1.2 A lineman's dial telephone set is connected by clipping to the terminals marked DIAL.

4.2 Test Procedure

After connections have been made to the circuit to be tested the following procedure is followed.

4.2.1 Place the FUNCTION switch in the DIAL & LINE MA position. Line current may be measured on the MA scale before dialing.

4.2.2 Dial the number of the milliwatt generator in the C.O. After a connection is established, the line current may be checked again.

4.2.3 Turn the FUNCTION switch to the CKT LOSS position and press the PUSH TO MEAS button. This turns the set on; it must be held in place until the measurement has been made. Readings are

made on the CKT LOSS scale of the meter which is calibrated from 0 to -10 dBm in 1 dB divisions and has a mark at -15 dBm.

4.2.4 Noise measurements are made by first repeating 4.2.1 and then dialing the number of the quiet (or balance) termination in the C.O. When a connection has been established, turn the FUNCTION switch to the CKT NOISE position and press the PUSH TO MEAS button. The reading on the CKT NOISE scale on the meter is the noise metallic on the line. If the meter should read off scale, press the ADD 20 DB pushbutton switch; this should bring the meter pointer within the measuring scale of the meter unless the noise is excessively high. Add 20 dB to the meter reading to get the exact value of circuit noise (or noise metallic) if it is necessary to push the ADD 20 DB button.

4.2.5 PWR INFL, or noise to ground measurements, are made while connected to the quiet termination at the C.O. by turning the FUNCTION switch to the PWR INFL position and reading the top scale on the meter. The PWR INFL scale is calibrated to read the noise to ground directly; it takes into account the 40 dB addition usually required for the attenuation in the input circuit in noise measuring sets. If the meter should read off scale, press the ADD 20 DB pushbutton switch; this should bring the meter pointer within the measuring scale of the meter unless the noise is excessively high. Add 20 dB to the meter reading to get the exact value of power influence (or noise to ground) if it is necessary to push the ADD 20 DB button.

4.2.6 It is possible to listen to the signal by plugging an earphone of the type used with the W.E. Co. 147 type amplifier or 3 type noise measuring sets, in the PHONE jack. This will not interfere with the measurement.

4.2.7 A battery test may be made by turning the FUNCTION switch to the BATT TEST position and pressing the PUSH TO MEAS button. If the meter does not read in the GOOD area, the batteries should be replaced, in accordance with instructions under 6.0 MAINTENANCE.

5.0 APPLICATION NOTES

5.1 The measurement ranges of the T136B have been designed to be within the normally acceptable limits of circuit loss, noise metallic, and noise to ground. The colored segments of the meter scale indicate the various degree of performance acceptability when direct readings are made on the meter; i.e., when it is not necessary to press the ADD 20 DB pushbutton switch. The significance of each color is as follows:

Green-- Acceptable performance

Yellow--Marginal performance.
Investigation of potential
troubles should be initiated.

Red --Unacceptable performance.
Immediate action required.

If it is necessary to press the ADD 20 DB button to bring the

meter pointer on scale, unacceptable performance is indicated and immediate action is required.

5.2 Measurements at the Subscriber's Location

Measurements may be made from the terminal block or protection block at the customer's premises. It is not necessary to disconnect the customer's equipment, but the equipment must be in the ON HOOK condition when measurements are made. The leads on the T136B are connected to Tip, Ring, and Ground as outlined in paragraph 4.1.1. A good ground, preferably the ground at the protector block, must be available to make power influence measurements.

5.3 Measurements at the C.O. Main Frame

Noise measurements may be made at the main frame in a C.O. toward the subscriber or toward the office equipment.

5.3.1 To Subscriber

Meaningful noise measurements can only be made toward the subscriber when there is a termination at the far end. The heat coils should be removed for this test. If a section of the subscriber's loop is to be measured, a termination should be connected at the far end of the section. Unterminated measurements will not provide useful data for analyzing noise problems; however, if a large number of unterminated loops are tested, useful statistical information can be compiled on the extent of noise problems on loops out of a C.O. A WILCOM Model T137 Circuit Termination Set will be useful in providing a termination at the far end.

5.3.2 To C.O. Equipment

It may be desirable to determine how much noise originates in the C.O. and what the balance is in the office equipment. Remove the heat coils and connect the T136B Green and Red leads to the Tip and Ring terminals toward the office equipment; the yellow lead should be connected to the office ground bus. Dial the quiet termination and make CKT NOISE and PWR INFL measurements.

If the induced longitudinal voltage is low, it may not be possible to make noise measurements. It is then necessary to introduce an external longitudinal voltage at a fixed frequency; any signal source between 500 Hz and 1000 Hz is satisfactory. The WILCOM Model T137 will be useful for providing a balanced terminating circuit to which a longitudinal voltage source can be connected.

5.4 Balance Measurements

Circuit balance can be determined from the CKT NOISE and PWR INFL measurements made with the T136B.

Balance (dB) = PWR INFL - CKT NOISE

The balance of a circuit will determine how susceptive it is to the induction of noise. The following values provide a guide for determining how good balance may be:

Balance	Condition
Over 60 dB	Excellent
50-60 dB	Good
40-50 dB	Fair
Under 40 dB	Poor

Usually any balance under 50 dB requires improvement, particularly when the power influence is high; i.e., over 75 dBrnc as measured on the T136B. If power influence is low a greater degree of unbalance can be tolerated; however if the power influence should increase, the circuit noise will increase proportionally. Therefore, it is good practice to get as high a balance as possible.

6.0 MAINTENANCE

6.1 Battery Replacement

6.1.1 The set only draws current when the PUSH TO MEAS switch is pressed; consequently, it is expected that the batteries will have close to shelf life. The batteries should be checked periodically by placing the FUNCTION switch in the BATT TEST position and pressing the PUSH TO MEAS button. If the meter does not read in the GOOD segment, the batteries should be replaced.

6.1.2 If a battery replacement is indicated, remove the four screws which have arrows pointing to them, and lift the panel from the case. Both batteries are plugged into battery terminals mounted on the printed circuit board. Merely pull the batteries out and insert new batteries in the terminals. Use Eveready No. 216 or equivalent; the NEDA No. is 1604.

6.2 Level Calibration

If there is any question about the accuracy of the calibration of the set, it may be checked in the following manner, using Fig. 7 for component location.

6.2.1 Equipment

A signal source of 1000 Hz capable of supplying output levels of 0 dBm and -60 dBm at 735 ohms in accordance with the arrangements shown in Fig. 6 is required.

6.2.2 CKT LOSS TEST

With the T136B connected to the calibrating arrangement shown in Fig. 4A set the oscillator output to 1.55 volts and place the T136B FUNCTION switch in the CKT LOSS position. The meter should read 0 on the CKT LOSS scale when the PUSH TO MEAS button is pressed. The accuracy of this test is determined by the accuracy of the oscillator level measurement. If the T136B reads more than 0.2 dB from 0, it is possible to adjust the gain of the set to set the meter pointer on zero, as follows:

6.2.2.1 Remove the four screws on the panel identified by an arrow pointing to each one, and lift the panel from the case.

6.2.2.2 The adjustment for circuit loss is a small square potentiometer located next to one of the meter terminals. Turn the adjustment screw until the meter reads zero when the proper signal is applied in accordance with Fig. 6A.

6.2.3 CKT NOISE TEST

The T136B should be connected in accordance with Fig. 6A; however, the Green lead should now be connected to terminal B which provides a signal 60 dB lower than that used for the CKT LOSS test. It may be necessary to readjust the oscillator level to 1.550 volts after the new connection is made. The meter should read 30 on the CKT NOISE scale when the FUNCTION switch is in the CKT NOISE portion and the PUSH TO MEAS button is pressed. If the reading deviates more than 0.2 dB from 30, it is possible to adjust the gain of the noise level measuring channel to set the meter on zero, as follows:

6.2.3.1 With the panel removed from the case, as in 6.2.2.1, apply the signal as in 6.2.3. The adjustment for circuit noise is a small round potentiometer mounted on the printed circuit board near the FUNCTION switch. Turn the adjustment until the meter reads zero. This sets the gain for the power influence measurement simultaneously.

6.2.4 PWR INFL TEST

The T136 should be connected in accordance with Fig. 6B and the output of the oscillator is set to .775 Volt. The red and green leads should be connected to the output terminal of the oscillator and the yellow lead to the ground terminal. The FUNCTION switch is now placed in the PWR INFL position. The meter should read 90 on the PWR INFL scale within 0.2 dB. If the deviation is greater than 0.2 dB, there may be a defect in the input circuit used for the PWR INFL measurement. Wilcom Products should be contacted for further information.

6.3 There should be little if any maintenance required except for replacement of batteries as outlined in 6.1. If any difficulties arise in the performance of the set and the batteries are in good condition, please contact Wilcom Products, Inc. for further information.

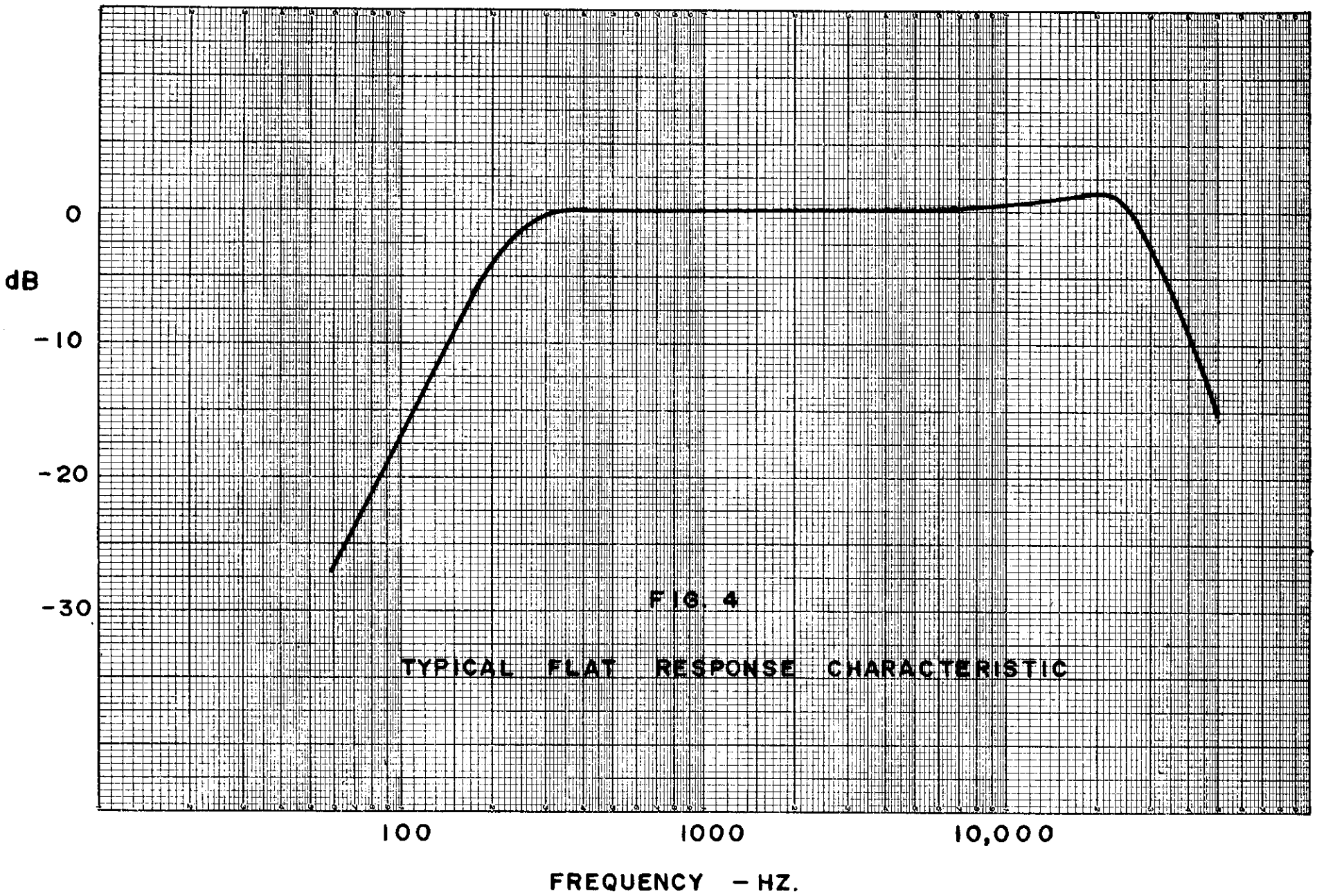


FIG. 4

TYPICAL FLAT RESPONSE CHARACTERISTIC

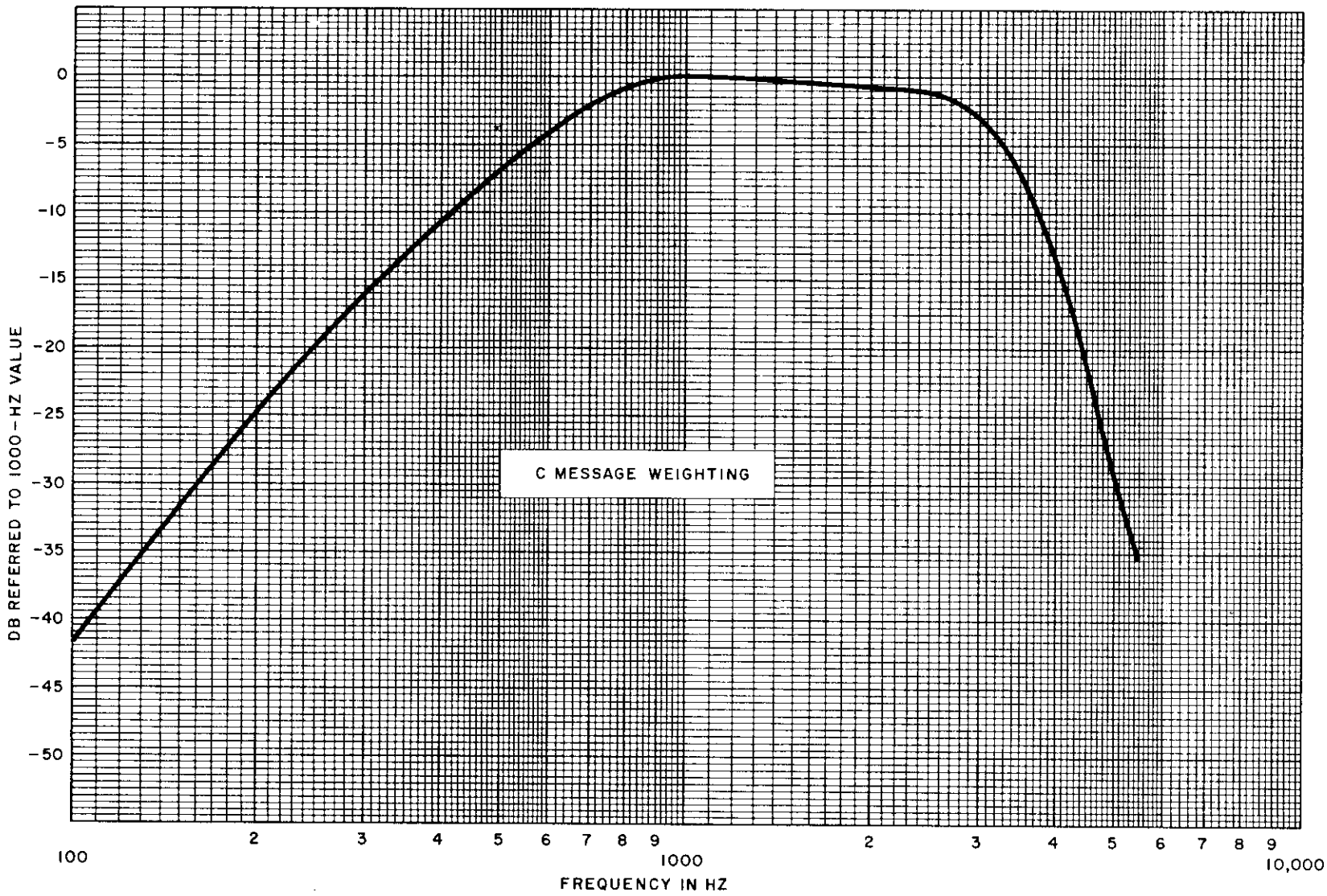
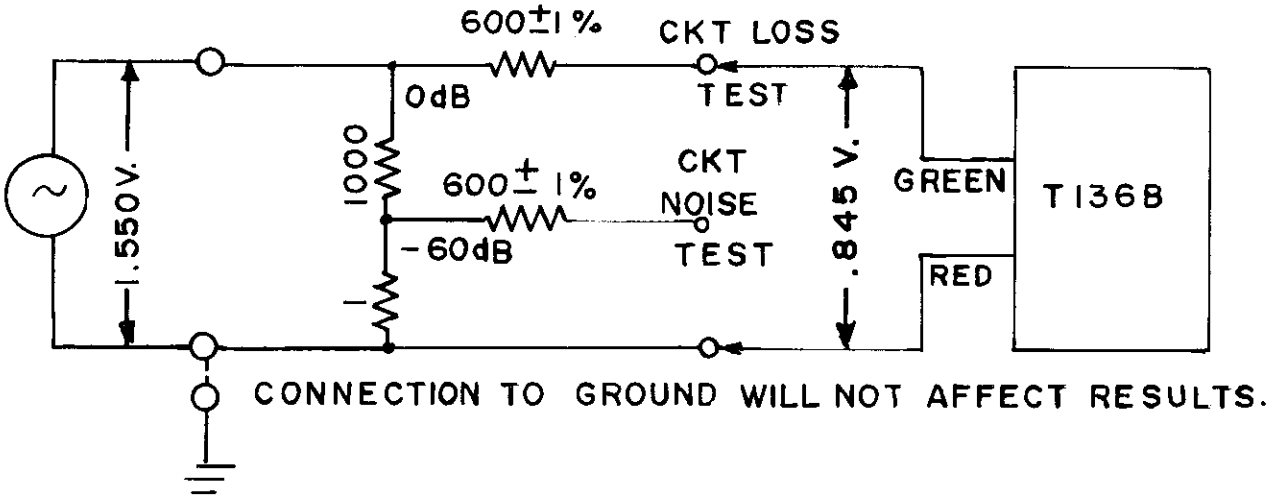


Fig. 5 —C Message Weighting Characteristic Curve

A. CIRCUIT LOSS AND CIRCUIT NOISE CALIBRATION



IF OSCILLATOR HAS 60 dB ATTENUATOR BUILT IN, EXTERNAL ATTENUATOR SHOWN ABOVE IS NOT NEEDED.

B. PWR INFL CALIBRATION

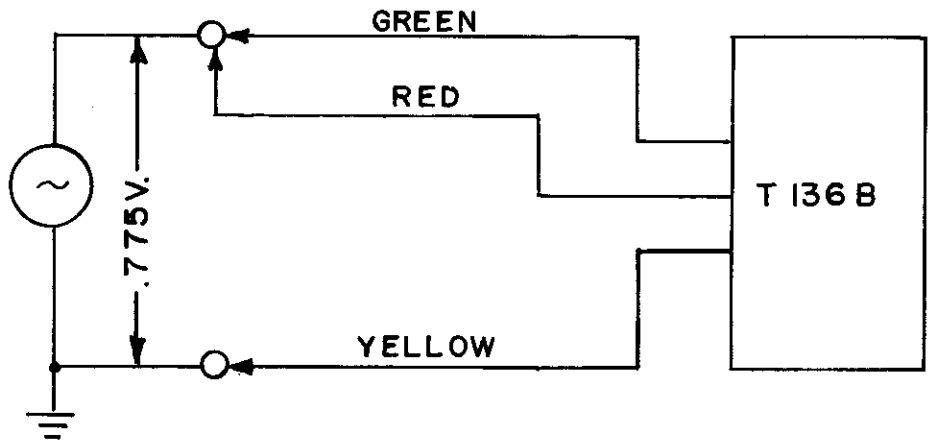


FIG. 6

CALIBRATION TEST CIRCUITS

WILCOM PRODUCTS, INC.
P.O. BOX 508
LACONIA, N.H. 03246
PHONE: 603-524-2622

MODEL T136B & BC PARTS LIST

C1 = 50 mfd 50V Electrolytic
C2 = 50 mfd 50V Electrolytic
C3 = .15 mfd 100V Mylar
C4 = .001 mfd " "
C5 = .0068 mfd " "
C6 = .0068 mfd " "
C7 = .015 mfd " "
C8 = 25 mfd 25V Electrolytic
C9 = .0022 mfd 100V Mylar
C10 = .0022 mfd 100V "
C11 = .02 mfd 500V Disc Ceramic
C12 = .01 mfd 100V Mylar
C13 = .01 mfd 100V "
C14 = .02 mfd 500V Disc Ceramic
C15 = 22 pf Disc Ceramic
C16 = .1 mfd Mylar
C17 = .018 mfd Mylar
C18 = .033 mfd "
C19 = .018 mfd "
C20 = 15 pf Disc ceramic

L1 = 4 Hy, 80 ma Choke
L2 = 265 Mhy Choke
L3 = 265 Mhy Choke

Q1 = 2N4355
Q2 = 2N3568

R1 = 100K, 1% RN55D
R2 = 100K, 1% "
R3 = 806 ohm, 1% RN55D
R4 = 60.4 ohm, 1% "
R5 = 8.06K, 1% "
R6 = 1000 ohm, 1% "
R7 = 10K, 1% "
R8 = 56.2K, 1% "
R9 = 165K, 1% "
*R10 = 16.5 ohm, 1% "
R11 = 18K, 5% IRC
R12 = 1.47K, 1% RN55D
R13 = Pot, 100K, Bourns 3389P
R14 = (B Model) 150K, 5%
(BC Model) 47K 5%
R15 = 18K, 5% IRC
R16 = 43.2K, 1% RN55D
R17 = 16.5K, 1% "

R18 = 10K, 5%
R19 = 7.5K, 5%
R20 = 220K, 5%
R21 = 2.2K, 5%
R22 = Pot, 5K, Clarostat
R23 = 3.65K, 1%
R24 = 3.65K, 1%
R25 = 4.7K, 5%
R26 = 220K, 5%
R27 = 10K, 1% RN55D
R28 = 10K, 1% "
R29 = 4.7K, 5%
R30 = 3.3K, 5%
R31 = 10K, 5%
R32 = 10K, 5%
R33 = 10K, 5%
R34 = 10K, 5%
R35 = 1.1K, 1%

T1 = 1: 1 Ratio TECO 3894-1

D1=1n4148
D2=1n4148
D3=1n4148
D4=1n4148

* (2 Resistors-Mounted on Switch S1)

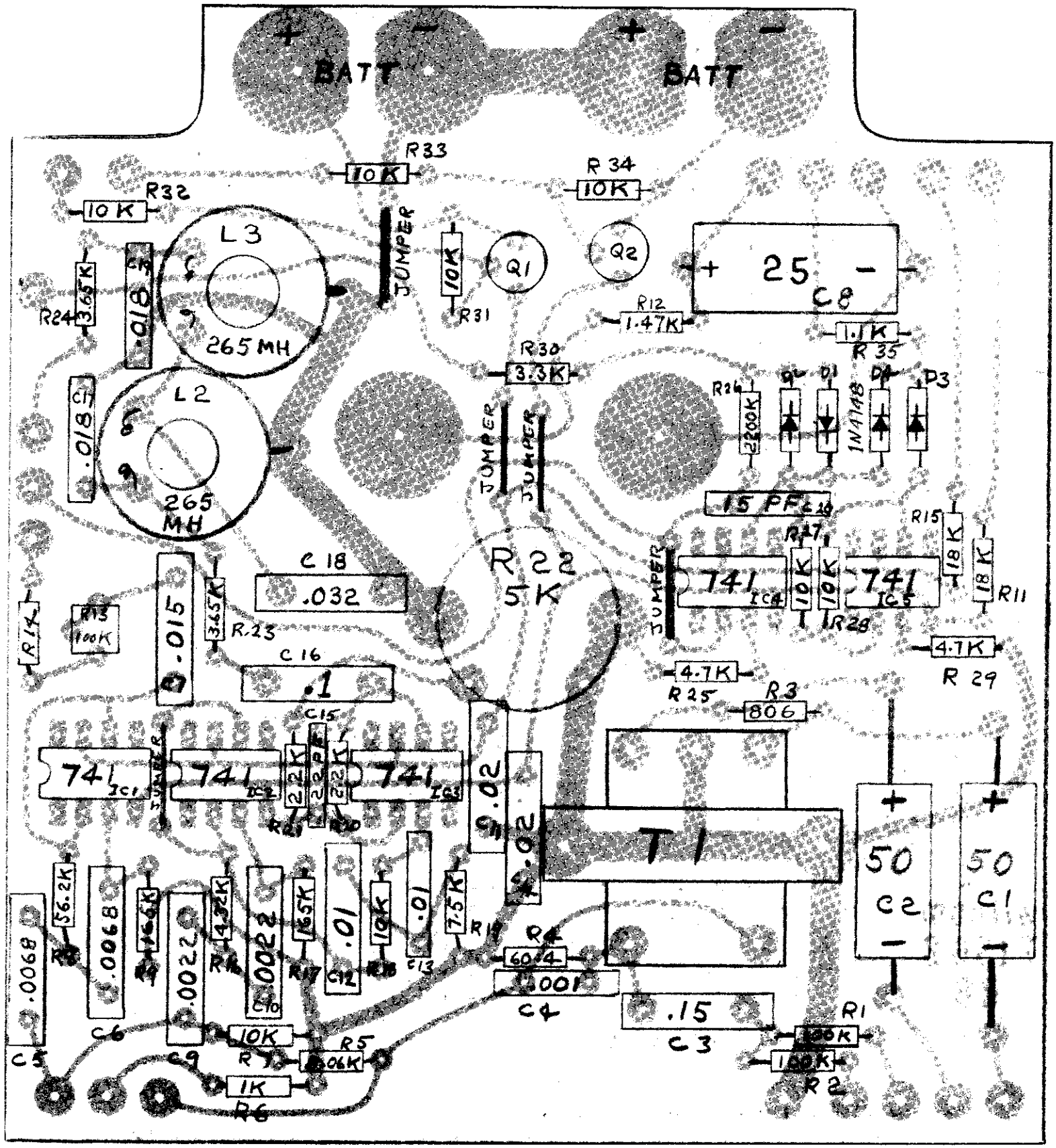

+ BATT −
+ BATT −
R33
10K
R34
10K
R32
10K
L3
265 MH
L2
265 MH
JUMPER
10K
R31
Q1
Q2
+ 25 −
C8
R12
1.47K
1.1K
R35
R30
3.3K
R24
3.65K
.018
C1
.018
JUMPER
JUMPER
R26
2200K
D1
D2
D3
1N4148
15 PF
C19
R15
18K
R17
10K
10K
R28
741
IC4
741
IC5
18K
R11
4.7K
R29
JUMPER
R22
5K
C18
.032
R23
3.65K
R13
100K
R14
.015
C16
.1
4.7K
R25
R3
806
C15
741
IC1
741
IC2
741
IC3
2.2K
2.2K
2.2K
R21
R20
.02
C11
.02
T1
50
C2
50
C1
56.2K
.0068
C6
.0068
C5
16.6K
R9
.0022
C9
4.32K
R8
.0022
C10
16.5K
R17
.01
C12
10K
R16
.01
C13
7.5K
R19
R4
60.4
.001
C4
.15
C3
R1
100K
100K
R2
10K
R7
R5
806K
1K
R6

FIG. 7

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