



Control Line Test Set R-1034A



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THIS DOCUMENT IS
DISCONTINUED

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SAFETY RULES

Caution

This tester has been designed with your safety in mind. However, no design can completely protect against incorrect use. Electrical circuits can be dangerous and/or lethal when lack of caution or poor safety practices are used.

Read The Manual

Read this Instruction Manual carefully and completely.

Voltages and currents within the capability of this test equipment can be hazardous. Follow the instructions in this manual for every measurement. Read and understand the general instructions before attempting to use this tester. Do not exceed the limits of the tester.

Safety Check

Double check the switch setting and lead connections before making measurements. Are you following all of the instructions?

Disconnect the tester or turn off the power before changing switch positions.

Do not connect to circuits with voltage present when switch is in any ohms or current position.

When replacing fuses use only specified type fuses and insert in correct fuse holder.

Don't Touch

Don't touch exposed wiring, connections or other "live" parts of an electrical circuit. If in doubt, check the circuit first for voltage before touching it.

Turn off the power to a circuit before connecting test probes to it. Be sure there is no voltage present before you touch the circuit.

Do not use cracked or broken test leads.

Distribution Circuits Pack A Punch

In high energy circuits such as distribution transformers and bus bars, dangerous arcs of explosive nature can occur if the circuit is shorted. If the tester is connected across a high energy circuit when set to a low resistance range, a current range, or any other low impedance range, the circuit is virtually shorted.

Special equipment designed for use with these circuits is available. Contact a qualified person for assistance before attempting to make measurements on any high energy circuit.

SAFETY IS NO ACCIDENT

SPECIFICATIONS

Physical Characteristics

Size	3 1/8" x 5" x 6 3/8"
Weight	3.5 lbs
Temperature Range	Storage -40 to +75°C Use 0 to +50°C
Vibration	Meets vibration portion of E.I.A. specification RS152B
Shock	Drop tested
Batteries	Two 9 Volt alkaline (60-82728J01) One 1 1/2 Volt "D" cell (60-82455G01)
Battery Life	9 Volt alkaline — 45 hours of continuous use

Electrical Specifications

Tone Generator	10 discreet tones 304, 404, 504, 750, 1004, 1950, 2175, 2800, 3000, 3200 Hz Output Level: -40 to +3dBm Output Impedance: 600 Ohms
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Frequency Accuracy 0 to +5%

Circuit Loss Range -60 to +3dBm
Accuracy ±.2dB at 0 to -10dBm (Line Level 1)
±.2dB at -20 to -30dBm (Line Level 2)

Frequency Response Flat
300 to 5 kHz, ±.3dB to 15kHz

Input Impedance 600 Ohms or bridging

Circuit Noise Range 0 to 33 dB rnc
Accuracy Meets Bell Technical Reference 41.009
"C" Message Curve Accuracy

Volt/Ohm Meter
DC Volts 0 to 30: Input res 1.2M Ohms: 40K/volt
0 to 300: Input res 1.5M Ohms: 5K/volt
Accuracy ±2% full scale

AC volts 0 to 30: Input res 300K Ohms: 10K/volt
0 to 300: Input res 1.5M Ohms: 5K/volt
Accuracy ±3% full scale

Ohms 3 ranges x1, x100, x1000: 10 Ohm center scale
Max Volts 1.5 volts
Max Current 150 mA
Accuracy ±3% of arc

Line Current Range 0 to 20 mA
Accuracy ±2% full scale



INTRODUCTION

The Control Line Test Set is a general purpose instrument designed for use in special service areas.

Incorporated in one tester are the most desired features for service and maintenance which previously required three pieces of equipment.

The tester consists of the following: A Volt-Ohmmeter with ranges and features specifically selected for telephone service and maintenance. A line measurement section designed to measure line parameters such as circuit loss, noise, and line current. A tone generator that generates 10 specific tones for testing line loss and quality.

The tester utilizes a rugged suspension type meter with colored scales to give qualitative as well as quantitative measurement indications.

The unit is housed in a rugged plastic case with a removable cover compartment used to store test leads and manual. The tester has an adjustable carrying strap so that it can be carried without the use of hands.

This manual was produced to aid the working technician in understanding Level Setting Procedures. Perhaps one of the most difficult and most common complaints to troubleshoot is the gradual system degradation. In addition to optimising the transmitters and receivers, it is often necessary to reset audio levels. Degradation can be caused by many factors including temperature, humidity, and in the case of TELCO Lines, cable plant rearrangements.

FUNCTION OF CONTROLS, JACKS AND TERMINALS

Selector Main Function

Selects desired measure function – line measurements, tone generator or Volt-Ohmmeter with 24 position switch. Meter “OFF” is the vertical position.

Meter-Line Level-Tone

This switch permits the operator to use the meter to monitor the output of the tone generator or the line (tip or ring) for circuit loss measurements.

Caution – The switch must be set in the LINE LEVEL position when making line loss or noise measurements, otherwise no reading will result.

Add 10 dB Push Button

Depressing the push button attenuates the incoming signals by 10 dB on line circuit loss, and noise and measurements.

It is used when the input signal level is beyond full scale. Depressing the button reduces the level 10 dB to give an on scale reading. To determine the signal level add 10 dB to the on scale reading.

Tone Level

Controls level of all tones generated and present at tone output jack. Level variation is approx. – 60 dBm to + 10 dBm terminated.

Ohms Adjust

Controls full scale indication when in the ohms function (X1, X100, X1K) when test leads are shorted together. When using the ohms function, the first step is to short test leads and adjust OHMS ADJ control to the Full Scale zero on the OHMS scale. The unit is then ready to make resistance measurements.

Bridging Terminating Switch

Selects the bridging or terminating mode. Used to make circuit noise and line level measurements.

Tone Output Jacks

Output from the tone generator is available between the TONE OUTPUT and the COM-jack, when the main selector switch is set to any of the TONE positions. The Red and Black test leads are used for connection to external circuits.

FUNCTION OF CONTROLS, JACKS AND TERMINALS (Continued)

Tip-Ring Input jack

The phone jack is located on the right side of the case and accepts the tip, ring cable assembly. When plugged in, the Green lead and clip is the TIP, the Red is RING. This input is used to make line measurements.

Volt-Ohmmeter Jacks

The two jacks VO and COM are used to make all AC-DC voltage and resistance measurements. The jacks accept the Red and Black test leads.

Meter

The meter has 6 scales for the following measurements: Line Level 1, Line Level 2, Ohms, AC-DC volts, circuit noise, and line current. The dB and line current scales are color coded to give qualitative indications when tests are performed.

OPERATING INSTRUCTIONS

GENERAL

To operate the tester perform the following steps:

1. Open cover and remove the test leads that will be used.
2. Check batteries by setting main function SELECTOR to BATT CK position. If batteries are at a useable level, the meter will indicate in the area of BATT OK arc. If batteries are to be installed refer to the maintenance section.
3. Check mechanical zero. This is done with the main function SELECTOR in the OFF position. If mechanical zero adjustment is required refer to the maintenance section.

LINE MEASUREMENT

Line mA

1. Plug in (TIP, RING) test lead assembly into phone jack located on side of tester. Connect alligator clips (TIP, RING) to telephone line terminals observing configuration tip to tip, ring to ring, etc.

OPERATING INSTRUCTIONS (Continued)

2. Set main SELECTOR switch to + (plus) LINE mA or - (minus) LINE mA depending on polarity. If a down scale reading is observed the selector is moved to the opposite polarity.
3. The 0-20 mA line current scale of the meter is read.

Line Loss

1. Plug in (TIP, RING) test lead assembly into phone jack at side of tester. Connect (TIP, RING) alligator clips to telephone line terminals observing configuration tip (Green) to tip, ring (RED) to ring, etc. Use bridging position if other equipment is on the line.
2. Set, METER-LINE LEVEL-TONE switch to LINE LEVEL position.
3. When a tone from another 600 ohm audio source can be measured the main SELECTOR is switched to the LINE LEVEL position.
4. The signal loss is read on the LINE LEVEL scale in dBm. (It is assumed that a 0 dBm signal level is fed into the line by the 600 ohm audio source.)

Ckt Noise

1. Plug in (TIP, RING) test lead assembly into phone jack at side of tester. Connect (TIP, RING) alligator clips to telephone line terminals, observing configuration tip (Green) to tip, ring (Red) to ring, etc. Use bridging position if other equipment is on the line.
2. Set, METER-LINE LEVEL-TONE switch to LINE LEVEL position.
3. The main SELECTOR is switched to CKT NOISE position.
4. The noise is then read on the CKT NOISE scale. If it is below 20 dBnc (Green area) the noise level is acceptable. If it indicates in the (Yellow area) 20 to 30 dBnc it is marginal, if in the Red it is unacceptable.
5. If the reading is beyond full scale the ADD 10 dB push button should be depressed. If an, on scale, reading is then observed, 10 dB should be added to the reading obtained. The reading would be in the Red bracket and is unacceptable.

OPERATING INSTRUCTIONS (Continued)

GENERATOR FUNCTION

Tone

1. Set main **SELECTOR** to any 10 tone positions.
2. Set **METER-LINE LEVEL-TONE** switch to **TONE** position.
3. The Red **VO** test lead is plugged into the **TONE** jack. The Black **VO** test lead is plugged into the **COM**-jack. The tone output is available across the Red and Black leads for connection to an external circuit.
4. Tone level is adjusted by varying the **TONE LEVEL** control.
5. The meter will monitor the tone output level with the meter switch in the **TONE** position.
6. Tone level is adjusted to 0 dBm using the **LINE LEVEL 1** scale. Note – The Tone Output is transformer isolated.

VOLT-OHMMETER

AC-DC Voltage Measurements

Plug Volt-Ohmmeter test leads in appropriate jacks, Red in **VO**, and Black in **COM**.

Set function **SELECTOR** to desired voltage range. Connect test probes to voltage to be measured and read on appropriate arcs either 0-30 or 0-300 Volts.

Resistance Measurements

Ohms **X1-X100-X1K**-Plug test leads in appropriate jacks, Red in **VO**, Black in **COM**. Set to desired range-short test leads together and adjust **OHMS ADJ** control for full scale zero on the meter. Next, connect test leads to resistance to be measured and read on the uppermost ohms arc applying the proper multiplier. For example, if the **X100** range is used the reading is multiplied by 100, etc.

OPERATING INSTRUCTIONS (Continued)

I. AUDIO & TONE MEASUREMENT APPLICATIONS

A. General

In a two-way radio communication system, the audio levels between various radio installations and control points must be adjusted for the specific applications to assure optimum performance.

B. DBM – Decibel referenced to 1 Milliwatt

DBM is a symbol indicating a power level with respect to 1 milliwatt. It shows the number of dB (ratio) above or below 1 milliwatt. Zero dBm is equal to 1 milliwatt. Although this definition does not necessarily imply a 600-ohm impedance, most AC voltmeters are calibrated in terms of dBm across 600 ohms. In this case, using the formula $P = E^2/R$ we get: .001 watt = $E^2/600$ OR $E = .77$ volt across 600 ohms for 1 milliwatt = “0” dBm.

Since “0” dBm is a special definition of the dB equation, any level above or below it has the same dB relationship to zero as the dBm value itself. For example, +6dBm of signal is 6dB above 0dBm. In voltage terms this would be 6dB above .77 volt which is 1.54 volts.

C. VU (Volume Unit)

When adjusting audio levels, it must be remembered that speech is a complex nonperiodic waveform which is difficult to measure.

VU is a measurement of speech, which can be made only with VU meter. This meter has special characteristics to control the rise and fall time overshoot for measurement of speech signal voltages. Thus, an indication of the “loudness” or volume of the signal may be determined.

Adjustment of audio line levels is very difficult using actual speech signals which fluctuate widely. A sinewave signal (1000 hz continuous tone) is much easier to use. A procedure for audio level adjustments using a 1000 hz sinewave signal is included in this manual.

D. REPORTING A TELCO CIRCUIT OUTAGE:

1. Report the outage to the local TELCO repair services.
2. Give the circuit number.

OPERATING INSTRUCTIONS (Continued)

3. Give the location of each termination point for the circuit.
4. Give symptoms of the complaint.
5. Pass on any pertinent data or results of test measurements made.
6. Give your name and telephone number where you can be reached.
WHEN REPORTING A TELCO CIRCUIT PROBLEM – REMEMBER HOW DIFFICULT IT IS TO REPAIR A RADIO WHEN YOU ARE ONLY TOLD “IT DOESN'T WORK”!!!

E. LINE LEVEL SETTINGS

1. General (Refer to Diagram No. 1)

Diagram #1 shows a basic remote control system. It can be divided into three parts. On the left is the remote control console, on the right the base station and in the center, the leased telephone company lines.

Perhaps the most restricting factor in the system is the leased TELCO lines. The telephone companies place restrictions on the levels that can be applied. This is understandable from the TELCO's point of view, since too high a level can cause crosstalk with other lines in their system. On the other hand, the higher the level that our system can have on the lines, the better the signal-to-noise ratio. For this reason, many of the settings will be predicated on the levels allowed on the leased lines. These vary from one TELCO to another and will have to be determined for your particular system.

2. Transmit and Receive Level Setting

Let's follow the audio path in Diagram #1 and discuss the adjustments one by one.

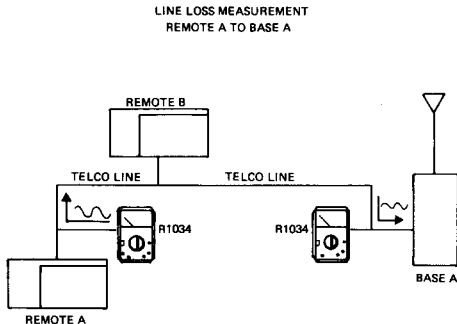
A typical application of the R-1034 would be to measure line losses from REMOTE A to BASE A.

Losses are checked by transmitting a test tone from REMOTE A at a specific power level and then measuring the level at the distant end (BASE A).

The carefully selected tones provide the capability to do a frequency sweep of the line to maintain a record of the response. This makes the test

OPERATING INSTRUCTIONS (Continued)

repeatable for future reference of system characteristics. See record keeping chart in back of this text.



The recommended practice is to set output levels to the maximum signal amplitude which is allowed on the lines.

Therefore, transmit level pots at REMOTE A should be adjusted for the maximum line level allowed by the local telephone company. We'll call it 0dBm. Other remotes can then be adjusted according to the remaining loss to BASE A in order that all audio reach the base station (BASE A) at the same level.

Our example has a loss REMOTE A to the base of -16 dB. Loss from REMOTE B is -13 dB. Therefore the output level from REMOTE A is set to the maximum level allowed (0dBm) and REMOTE B output level is set for -3 dBm. DIAGRAM #2.

This allows all console originated audio to reach the base station at the same level no matter from which source.

Base station levels are also set by injecting -16 dBm directly into the base station. This is the level seen by BASE from either source. Adjust the exciter pot for typically a plus or minus 3 kHz deviation. Voice peaks will provide a full 5 kHz deviation.

OPERATING INSTRUCTIONS (Continued)

TRANSMIT LEVEL SETTING

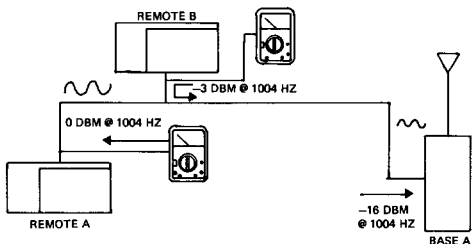


DIAGRAM #2

3. Receive Level Setting

Proper receive level setting requires the same accuracy with the worst case losses generally being at the end point (REMOTE A) and other remotes (REMOTE B) being set for compression at a higher level. DIAGRAM #3.

RECEIVE LEVEL SETTING

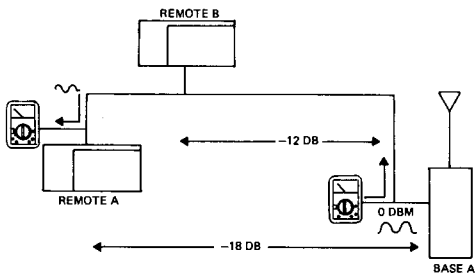


DIAGRAM #3

OPERATING INSTRUCTIONS (Continued)

In our example the loss from the base to REMOTE A is -18dB .

Loss from REMOTE B is -12dB . To set the compression level subtract this loss from the maximum output level setting allowed (0dBm).

For REMOTE A inject a -18dBm signal @ 1004 Hz into the screw terminals and adjust the input line level pot for the knee of compression.
DIAGRAM #4.

RECEIVE LEVEL SETTING

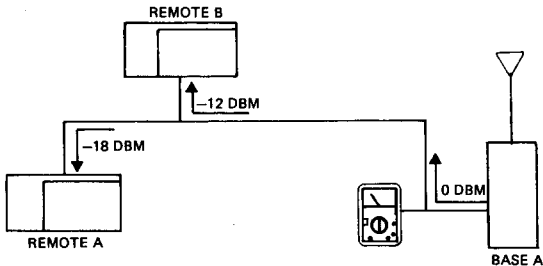


DIAGRAM #4

Repeat the procedure for REMOTE B using a -12dBm @ 1004 Hz signal.

Base station receive audio level is set by injecting the carrier signal modulated at 1000 hertz and 3KHz deviation using a service monitor tuned to the station receive frequency.

Set the output level pot for again the maximum allowable level (0dBm).

Consult National Service Technicians Guide TT101 SYSTEM AUDIO LEVEL setting for more detailed level setting procedures.

OPERATING INSTRUCTIONS (Continued)

F. Phone Line Noise Measurements

1. General

The C-Message Weighted Filter could be the most valuable feature incorporated into the R-1034 design. The circuit noise meter was designed and built to measure phone line noise as the phone company would. The repairman or installer may make a circuit loss and noise measurement at the time of install of the TELCO circuit. These measurements are through a "C" Message weighting filter, in other words the noise measurement will only see noise in the 300 to 3000 Hz band. The "C" Message filter will attenuate all other frequencies according to its weighting curve. The dabrenco scales (dBrnc) are used to evaluate noise levels and are the decibels above reference noise. Reference noise (0dBrnc) is equivalent to the disturbing effect of a -90dBm , 1000Hz tone.

The 2-way technician needs to be aware of this type noise measurement. Noise above 3000 Hz will cause general system degradation to the 2-way radio system even though this high frequency noise is within TELCO specs as measured through the "C" Message filter. The local TELCOS can be very co-operative with resolving this type of problem. They must however, be informed of the problems as a special services team will be required to make the proper measurements. A normal TELCO repairman may not be aware of how to make unweighted noise measurements but C-Message measurements is data important to him.

If noise problems are apparent in the C-Message range, that information can be given to the telephone company. If flat weighted noise is a problem, the R-1034 also provides a flat frequency response for these measurements. See reporting a TELCO circuit outage.

2. Noise Measurement

The weighting filter averages thermal noise and provides the dBrnc (Dabrenco) meter scales, color coded, to identify the acceptable noise levels.

First, the line must be quiet with no activity. Just connect the test leads across the quiet line in the bridging or terminating mode and measure the C-Message weighted noise just as the phone company would.

OPERATING INSTRUCTIONS (Continued)

Flat weighted noise measurements are also possible in the LINE LEVEL 1 or 2 positions. Again just connect the test leads across the line in the bridging or terminating mode and measure the flat weighted noise. Repeating the measurements at all available termination points on the line under service will provide even more complete data to the TELCO.

MISCELLANEOUS OPERATING HINTS

For extended battery life, the tester should be turned off when not in use - maximum current drain occurs when the SELECTOR is in any of the tone positions. No current is drawn on any of the Volt-Ohmmeter or line current positions.

Note: the main selector switch vertical position is the "OFF" position.

Batteries and fuse are located at the top rear of tester. Access to compartment is achieved by loosening one screw at rear of tester. With screw disengaged lift cover up and out. The cover is replaced in the reverse order.

Test cable and test leads are stored in the cover. The test leads should be neatly wound into a small bundle and inserted behind a plastic compartment door.

MAINTENANCE

CAUTION DISCONNECT TEST LEADS FROM EXTERNAL CIRCUIT BEFORE SERVICING TESTER

BATTERY TEST AND REPLACEMENT

Batteries: 2 9 Volt 60-82728J01
1 1.5 Volt 60-82455G01

The two 9 Volt batteries supply power to the loop tester circuits.

One 9 Volt battery is located to the left of the 1.5 Volt battery and other 9 Volt battery is located behind the 1.5 Volt battery. The 1.5 Volt battery must be removed to gain access to the second 9 Volt battery.

The condition of the two 9 Volt batteries is indicated by the position of the pointer with respect to the BATT OK arc on the dial when the main selector is placed in the BATT CK position. If the pointer is below this arc the two 9 Volt batteries should be replaced.

The 1.5 Volt battery supplies power to the ohms functions. If the pointer cannot be adjusted to zero with the leads shorted on the ohms range the 1.5 Volt battery should be replaced.

See DIAGRAM 5 for battery location.

BATTERY COVER

Access to the battery and fuse compartment is gained by removing the battery cover on the back of the tester. Loosen battery cover screw and lift cover up and push towards the top of the tester. Reverse the above procedure to replace the battery cover.

FUSE REPLACEMENT

FUSE: 1 1 AMP, 250 V 3 AB.

The 1 Amp fuse is in the circuit for all volt-ohm functions.

Spare fuse is located beside the 9 Volt battery. If the tester becomes inoperative, the fuse and batteries should be checked.

MAINTENANCE (Continued)

The 1 Amp fuse is removed as follows: With finger, push fuse clip toward side of case, the fuse will pop up and out for removal. When inserting new fuse, use test lead probe tip to assist in installing new fuse.

Refer to BATTERY COVER section for gaining access to the fuse.

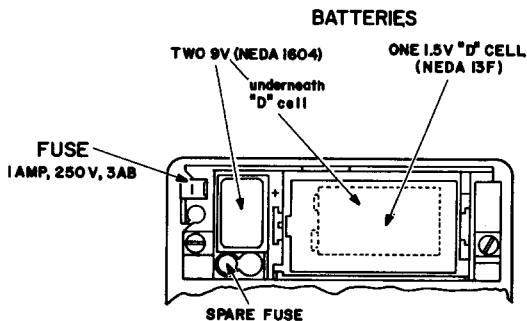


DIAGRAM #5

CALIBRATION

Note – Other than the mechanical zero adjustment, the major calibration adjustments should not be attempted in the field.

Should calibration be necessary, voltage and current sources of .2% or better accuracy should be used and the sequences listed below should be followed. See Figure 5 for visual instructions to remove instrument from case for calibration.

1. Mechanical Zero

- A. Place tester on back on level surface.
- B. Set main SELECTOR to OFF position.
- C. Adjust meter pointer for zero indication with zero adjust screw. (Zero adjust screw located above OFF position of main SELECTOR).

MAINTENANCE (Continued)

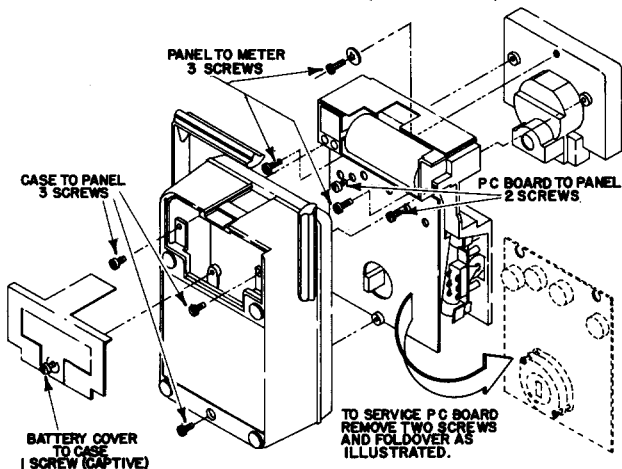


DIAGRAM #6

2. Meter mV Calibration

- A. Remove tester from case. DIAGRAM #6.
- B. Set main SELECTOR to 30 VDC position.
- C. Remove 2 screws holding P.C. board. DIAGRAM #6.
- D. Pull P.C. board off switch shift and fold over to side.
- E. Connect 100 mV source to meter leads on "A" deck (Red +, Black +).
- F. Adjust R25, (1.75K variable resistor on back of meter) for full scale reading. DIAGRAM #7.
- G. Replace P.C. board on tester panel.

3. Volt-Ohm Functions

- A. Accuracy of these functions is determined by fixed resistors. If they are out tolerance, either the meter has not been accurately calibrated or the resistors associated with the respective ranges are out of tolerance.

MAINTENANCE (Continued)

4. Line mA

- A. Accuracy of this function is determined by the meter calibration and the tolerance of the 5 ohm shunt R7 +2%.

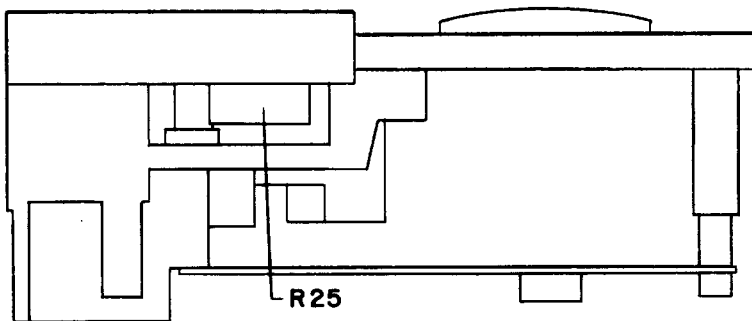


DIAGRAM #7

5. Line Level

- A. Set main SELECTOR to LINE LEVEL 1 position.
B. Insert test lead assembly into jack on right side of tester.
C. Set METER switch to LINE LEVEL 1.
D. Connect TIP (Green) and RING (Red) to a monitored 774 mV, 1000 Hz source.
E. Adjust R44 for 0 dB on LINE LEVEL 1 scale. Refer to DIAGRAM #8 for location of R44.

6. Ckt Noise

- A. Set main SELECTOR to CKT NOISE position.
B. Set METER switch to LINE LEVEL position.
C. Connect TIP (Green) and RING (Red) to a monitored 774 mV, 1000 Hz source.

MAINTENANCE (Continued)

D. Adjust R38 for 0 dB indication. Refer to **Dia. 8** for location of R38.

7. Tone Generator

A. Set main SELECTOR to 1004 Hz position.

B. Set METER switch to TONE position.

C. Connect TONE jack and COM jack to frequency counter.

D. Adjust R64 for 1004 Hz.

E. Repeat first three steps for 1.95 kHz frequency.

F. Adjust R67 for 1.95 kHz. Refer to **Dia. 8** for location of R64 and R67.

G.. Check other frequencies which are calibrated to within -0 to $+5\%$ by fixed resistors.

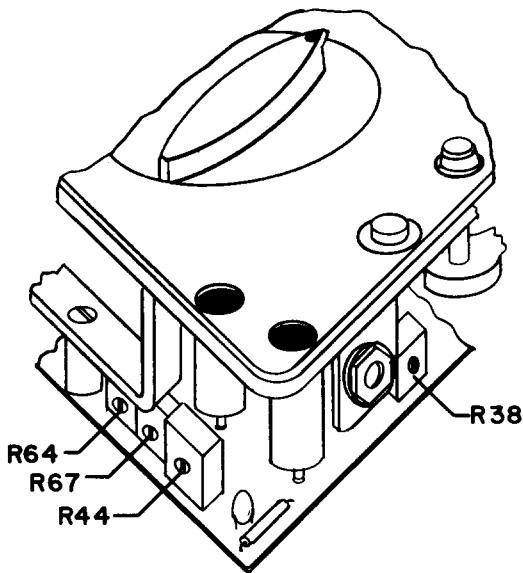


DIAGRAM #8

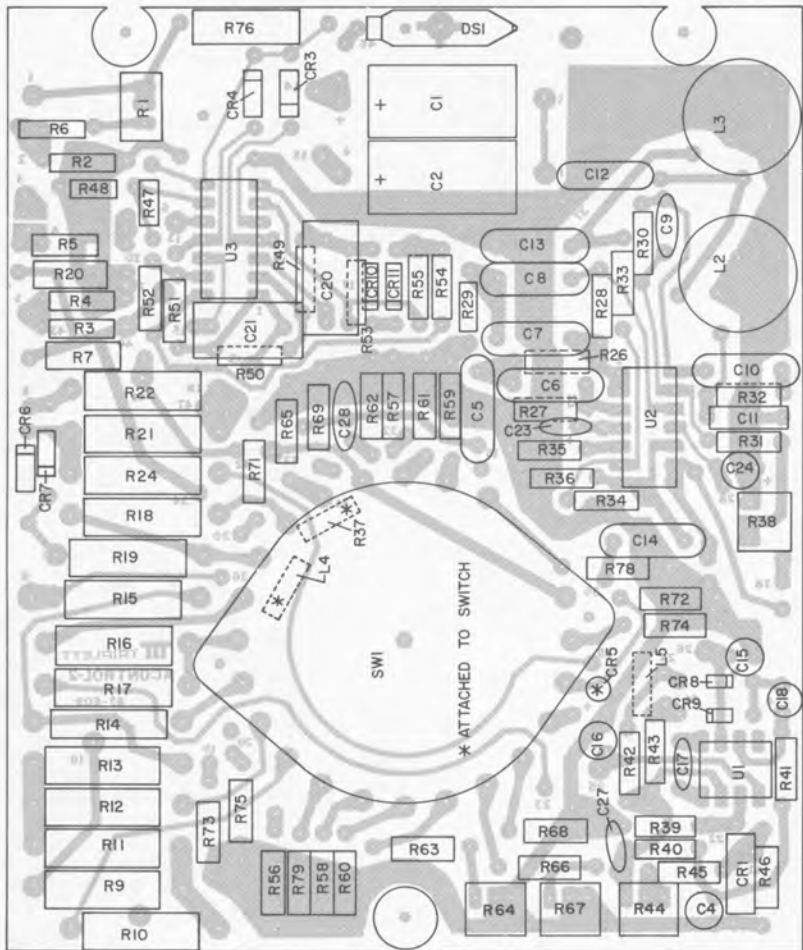
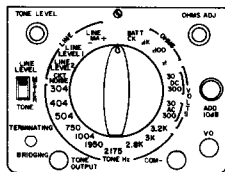
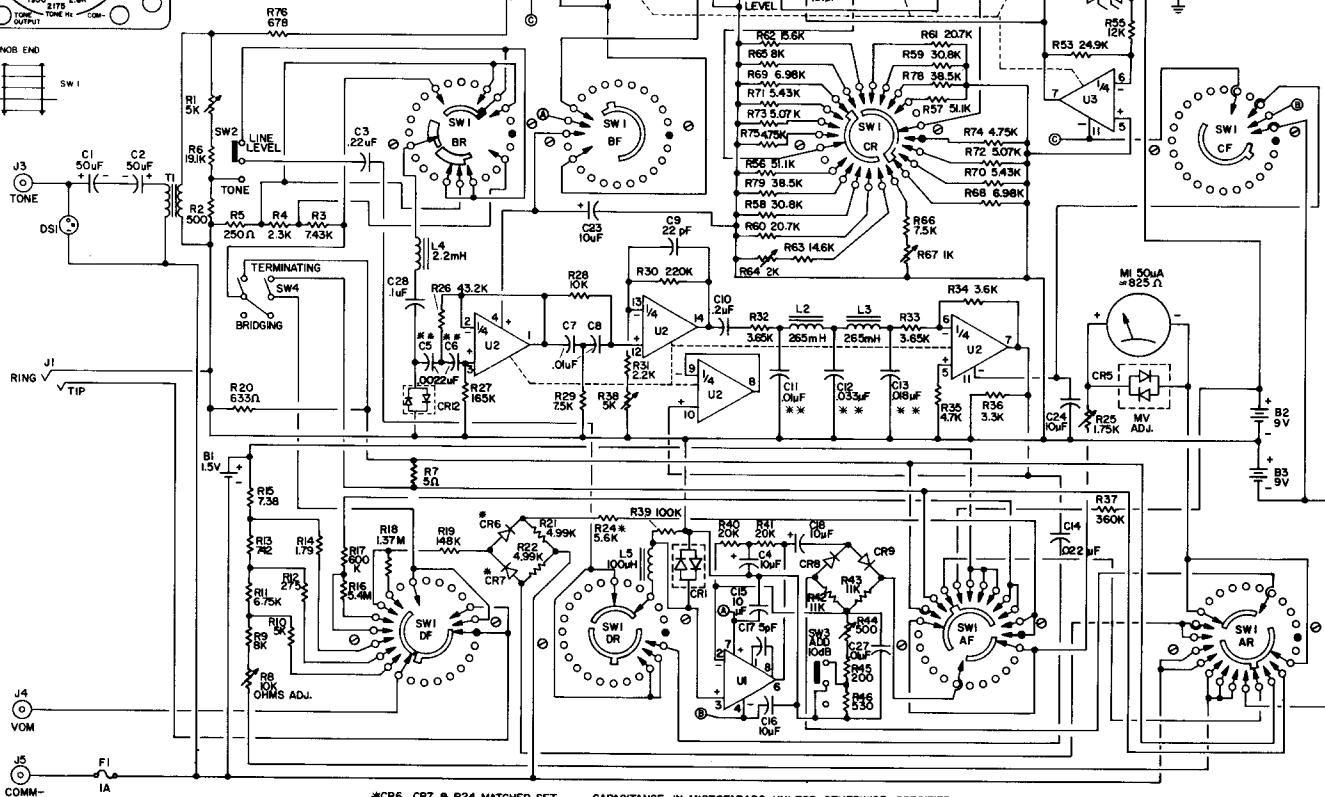
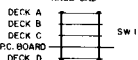


DIAGRAM #9
Component Layout



ROTARY SWITCH SHOWN IN OFF POSITION.
ROTARY SWITCH DECKS VIEWED FROM KNOB END.



*CR6, CR7, & R24 MATCHED SET. CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
** MAY BE SELECTED TO 5%. R56 THRU R79 MAY BE SELECTED FOR REQUIRED FREQUENCY.

DIAGRAM #10

Schematic

CONTROL LINE TEST SET MANUAL PARTS LIST

Reference Symbol	Motorola Part No.	Description
BT 1	60-82455G01	Battery 1.5V
BT 2,BT 3	60-82728J01	Battery 9V
C1,C2	23-80398A46	Cap 50 UF 50V - 10% +75%
C3	08-80398A09	Cap Poly Film .22UF +/- 10%
C4,C15,C16,C18,C23,C24	23-84538G01	Cap Tant 10UF 25V 20%
C5,C6	21-80398A47	Cap .0022 UF 5%
C7,C8,C11	21-80398A48	Cap Film .01UF 10%
C9	21-80398A49	Cap Ceramic Disk 22PF 10%
C10	08-80398A50	Cap Metal Poly .22UF 10%
C12	21-80398A51	Cap .033 UF 5%
C13	21-80398A52	Cap .018 UF 5%
C14	08-80398A53	Cap Mylar .022UF 10%
C17	21-80398A54	Cap Disc 5PF 15V 20%
C19	21-80398A55	Cap Disc 82PF 10%
C20,C21	08-80398A56	Cap Poly .01UF 1%
C27	21-80398A57	Cap Disc .01UF 100V 20%
C28	08-80398A58	Cap Poly .1UF 100V 20%
CR1,CR5,CR12	48-80398A59	Diode
CR3,CR4	48-82466H18	Diode
CR6,CR7	48-80398A60	Diode
CR8,CR9	48-84553A06	Diode
CR10,CR11	48-86863A04	Diode Zener
DS 1	65-80398A61	Lamp. Neon
F 1	65-80398A11	Fuse. Spare. 1 Amp
J 1	9B82281C01	Jack Phone
L2,L3	25-80398A62	Choke 265 MH
L4	24-80398A63	Choke Assy RF
L5	24-80398A65	Choke 100 UH
M1	72-80398A03	Motorola Control Line Test Meter
R1,R38	18-83452F11	Resistor Var. 5K 20%
R2	06-80398A16	Resistor 500 Ohm Prec
R3	06-80398A17	Resistor, Film, 7.43K 1%
R4	06-80398A18	Resistor, Fixed film

CONTROL LINE TEST SET MANUAL PARTS LIST (Continued)

Reference Symbol	Motorola Part No.	Description
R5	06-10621B36	Resistor 250 Ohm Prec
R6	06-10621D19	Resistor 19.1K 1/8 W 1%
R7	06-80398A19	Resistor WW 5 1%
R8,R23	18-80398A10	Res Var Comp 10K +/- 20%
R9	06-80398A20	Resistor 8K
R10	06-80398A21	Resistor 5K 1%
R11	06-80398A22	Resistor 6.75K 1%
R12	06-80398A23	Resistor 275 1%
R13	06-80398A24	Resistor 742 1%
R14	17-80398A24	Resistor 1.79 1%
R15	17-80398A25	Resistor 7.38 1%
R16	06-80398A26	Resistor 5.4M 1/2 W 1%
R17	06-80398A27	Resistor 600K
R18	06-80398A28	Resistor 1.37 M 1%
R19	06-80398A29	Resistor 148K 1%
R20	17-80398A30	Resistor 633 3W 1%
R21,R22	06-80398A31	Resistor 4.99K 1%
R24	06-80398A32	Resistor 5.6K 1%
R26	06-10621D53	Resistor 43.2K 1%
R27	06-10621E10	Resistor 165K 1%
R28	06-124A73	Resistor 10K 1/4 W 5%
R29,R66	06-10621C79	Resistor 7.5K 1/8 W 1%
R30	06-124B06	Resistor 220K 1/4 W
R31	06-124A57	Resistor 2.2K 5%
R32,R33	06-10621C49	Resistor 3.65K 1/8 W 1%
R34	06-124A65	Resistor 3.6K 5%
R35	06-124A65	Resistor 4.7K 1/4 W 5%
R36	06-124A61	Resistor 3.3K 1/4 W 5%
R37	06-124B11	Resistor. Fixed Comp.
R39	06-124A97	Resistor 200K Comp.
R40,R41,R47,R48	06-124A80	Resistor 20K Comp.
R42,R43	06-124A74	Resistor 11K 5%
R44	18-83452F07	Resistor Var. 500
R45	06-10621B27	Resistor 200
R46	06-80398A36	Resistor 530 1%
R49,R50,R51,R52,R53	06-10621D30	Resistor 24.9K 1%
R54,R55	06-80398A37	Resistor 12K 1%

CONTROL LINE TEST SET MANUAL PARTS LIST (Continued)

Reference Symbol	Motorola Part No.	Description
R56,R57	06-10621D60	Resistor 51.1K 1/8 W 1%
R58,R59	06-80398A38	Resistor Film 30.8K
R60,R61	06-80398A39	Resistor 20.7K
R62	06-80398A40	Resistor 15.6K 1%
R63	06-10621D08	Resistor 14.6K 1%
R64	18-83452F01	Resistor Var 2K 20%
R65	06-80398A41	Resistor 8K 1/8 W 1%
R67	18-83452F09	Resistor Var 1K 20%
R68,R69	06-10621C76	Resistor 6.98K 1/8 W 1%
R70,R71	06-80398A42	Resistor 5.43K 1%
R72,R73	06-80398A43	Resistor 5.07K
R74,R75	06-10621C60	Resistor 4.75K
R76	17-80398A44	Resistor WW 678 1%
R78,R79	06-80398A45	Resistor 38.5K
S 1	01-80398A14	Switch. Rotary W/Comp.
S 2	40-80398A13	Switch Assembly Rocker
S 3	40-80398A06	Switch
S 4	40-80398A07	Switch. Toggle Dpdt.
T 1	25-80398A08	Transformer.
U1	51-84561L22	Integrated Circuit
U2,U3	51-84561L75	Integrated Circuit
Non-Reference Parts		
	01-80398A68	Case Assy Model 3 TY 3
	15-80398A66	Cover Assy Model 3 TY 3
	15-80398A67	Cover, Battery Model 3
	36-80398A05	Rotary Switch
	01-80398A04	Test Lead & Hdwe Pkg.
	01-80398A02	Strap Web. Shoulder Model
	36-80398A12	Knob. Ohms Adjust