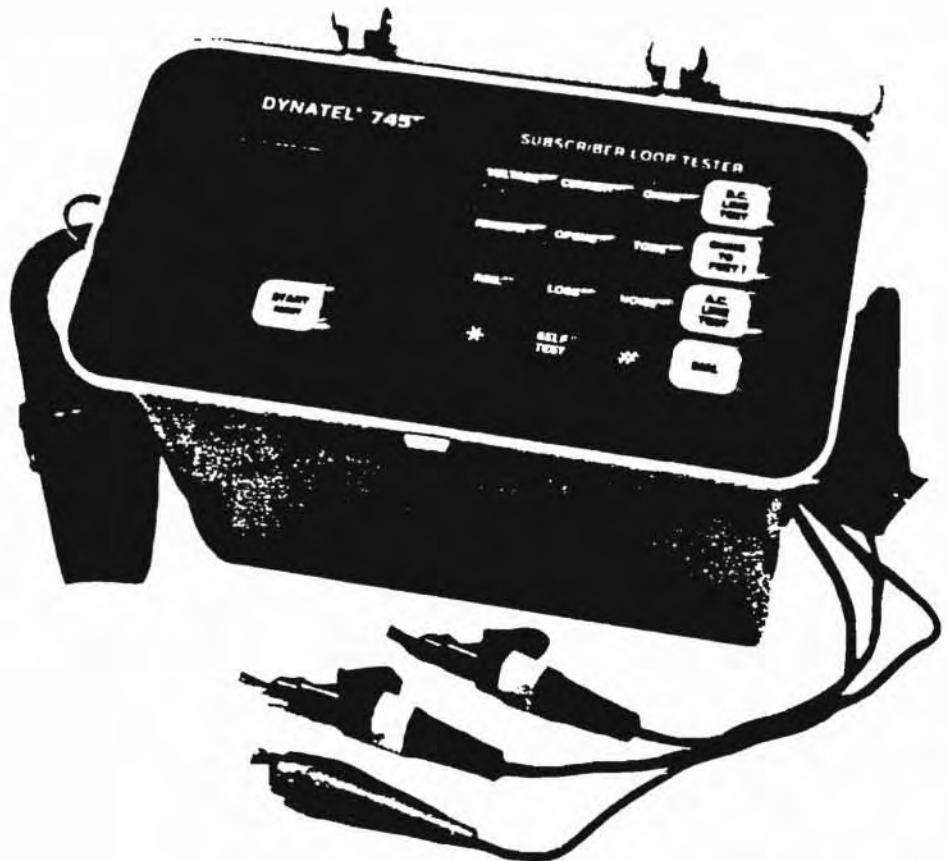


February, 1988

Dynatel® 745 Subscriber Loop Tester Operator's Manual



**DYNATEL 745 SUBSCRIBER LOOP TESTER
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3M DYNATEL SYSTEMS DIVISION
DYNATEL 745 SUBSCRIBER LOOP TESTER
DESCRIPTION

1. GENERAL

1.01 The Dynatel 745 Subscriber Loop Tester (SLT) is a micro-processor-based, intelligent field instrument, designed to diagnose problems on telephone subscriber loops from either the subscriber end or any easy-access terminal. With a single, three-clip attachment across the pair and to ground, the set performs test sequences in either an automatic or manual mode, and indicates results on a liquid crystal display. In automatic mode, test measurements are analyzed internally and the results displayed on a pass-fail basis. Where appropriate, suggested probable cause of trouble is displayed in plain language. In manual mode, test data is displayed for operator analysis.

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph.



Fig. 1-1 — The Dynatel 745 SLT

1.03 Comments concerning the content or organization of this document, as well as suggestions for improvement are welcomed. Direct comments to:

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Austin, TX 78769-2963
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1.04 The 745 SLT performs the following test measurements:

- a) AC and DC Voltage—detects and displays AC or DC voltage.

Note: If hazardous voltage is on the pair, the speaker sounds an alarm.

- b) DC Current—measures and displays DC loop current.
- c) Insulation Resistance—measures and displays resist-

ance between all three test clips. Wide variations of resistance are indicated by an audible signal.

- d) Ground Resistance—measures and displays ground resistance between the central office and the ground (green) test lead.
- e) Opens—measures pair capacitance and displays distance in feet to an open.
- f) Line Loss—measures circuit loss and signal frequency. Displays loss in dBm and frequency in Hertz (Hz).
- g) Slope and Bulge (Automatic Mode only)—automatically measures loss, computes slope and identifies circuit bulge.
- h) Ringer Count—counts and displays number of ringers connected to the pair.
 - i) Noise-Metallic, Power Influence and Balance—checks and displays circuit noise (noise across the pair) and power influence (noise-to-ground). Calculates and displays circuit balance.
 - j) Loop Treatment—determines loop treatment applied to line by type.
 - k) Loop Resistance—determines loop resistance and C.O. resistance on a working line.

1.05 The 745 SLT stores and dials commonly-used test line numbers both on command or as part of a test sequence. The operator may select either dial pulse or DTMF signaling. The built-in speaker allows monitoring of signals such as dial tone, test tones, and speech on a busy pair.

1.06 The set will test and analyze all commonly-used telephone cables, including air-core, jelly-filled and service drops.

1.07 The set is powered by a sealed lead acid battery which is rechargeable by separate DC supply.

1.08 If the set is left in one test mode for five minutes, a warning tone sounds and the set turns off a few seconds later.

Note: In TONE mode, set will operate for two hours before turning off.

1.09 An alarm sounds and VOLTAGE HAZARD is displayed when the voltage between any of the test clips exceeds 110 VDC or 100 VAC. When this condition is detected, only voltage measurements are permitted.

1.10 If a voltage greater than 65 VDC or 55 VAC between any of the test clips is measured, the set displays FOREIGN VOLTAGE. When this condition is detected, only VOLTAGE, CURRENT, and REG. measurements are permitted.

2. DESCRIPTION

2.01 The 745 Subscriber Loop Tester is a compact, lightweight, rugged test set housed in a high-density polyethylene case. It is bright yellow for high visibility and is water-resistant. A carrying strap is provided for operator convenience. The set's cover folds completely back to give access to the start key, the 16-key sealed-membrane control panel, and the liquid crystal display.

2.02 Three permanently-attached test leads are stored in a compartment in the rear of the set. They are color-coded as follows:

- a) Red clip to Ring
- b) Black clip to Tip
- c) Green clip to Ground

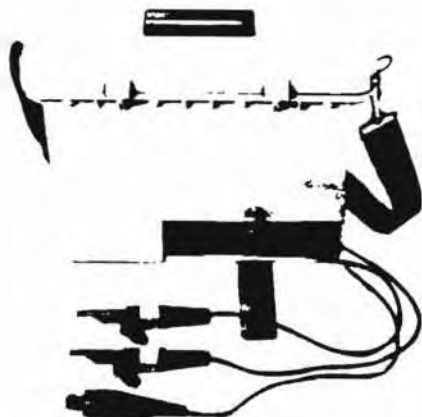


Fig. 1-2—745 SLT Test-Clip Stowage

2.03 The liquid crystal display provides a two-line, 16-character dot-matrix readout. Test results are displayed in plain language. When further test results or sequences are available, a star (*), a pound (#) sign, or both are displayed, allowing the operator to depress the appropriate key to continue the test, select options, or obtain further instruction.

3. SUMMARY OF SPECIFICATIONS

3.01 The following is a summary of specifications for the Dynatel 745 Subscriber Loop Tester.

MEASUREMENTS*				
Function	Range	Resolution	Accuracy ¹	Attachment
AC VOLTAGE:	0 to 75 VAC	0.1V	± 0.7V	R-T, R-G, T-G
	75 to 250 VAC	1V	± 3V	R-T, R-G, T-G
DC VOLTAGE:	0 to ± 100 VDC	0.1V	± 0.5V	R-T, R-G, T-G
	100 to 350 VDC	1V	± 3V	R-T, R-G, T-G
DC CURRENT	0 to 100 mA DC (Z _{in} = 430 Ohms)	0.1 mA	± 0.3 mA	R-T
RESISTANCE:	0 to 2000 Ohms	1 Ohm	± 5 Ohms	R-T, R-G, T-G
	2000 to 10,000 Ohms	10 Ohms	± 1%*	R-T, R-G, T-G
	10K to 100K Ohms	100 Ohms	± 2%*	R-T, R-G, T-G
	100K to 1 Megohm	1K Ohm	± 3%*	R-T, R-G, T-G
	1 Megohm to 30 Megohms	0.1 to 10 Megohms	± 10 to 30%*	
LOSS:	-40 to +10 dBm (Z _{in} = 600 Ohms)	0.1 dB	± 0.2 dB	R-T
		200 Hz—5KHz		
NOISE METALLIC:	0 to 50 dBmC (Z _{in} = 600 Ohms)	0.1 dB	± 0.5 dB	R-T
NOISE TO GROUND:	40 to 100 dBmC (Z _{in} = 100K Ohms)	0.1 dB	± 0.5 dB	R&T-G
			C-message weighting**	
OPENS:	0 to 2000 Feet	10 Feet	± 20 Feet	} Ring, } Tip, & } Mutual
	2000 to 5000 Feet	10 Feet	± 40 Feet	
	5000 to 20,000 Feet	100 Feet	± 200 Feet	
FREQUENCY:	20 to 20,000 Hz (during LOSS)	1 Hz	± 2 Hz	R-T
			(single frequency only)	
GROUND RESISTANCE:	0 to 500 Ohms	1 Ohm	± 3 Ohms	R, T & G

MEASUREMENTS, cont:

Function	Range	Resolution	Accuracy ¹	Attachment
LOOP RESISTANCE:	0 to 5000 Ohms (with C.O. battery connected)	1 Ohm	± 50 Ohms	R & G

*Percentage of reading.

**C-Message specification has an additional frequency dependent tolerance. Refer to 'Subscriber Loop Transmission Test Set Specification', Bell System PUB 55020, January 1982.

These specifications apply for the following operating environmental conditions:

OUTPUTS*

Output Attachment	Frequency	Remarks	
TONE:	577.5 Hz	Pure sine wave, pulsed or continuous	R-T
DTMF:	Standard	100 msec ON, 100 msec OFF (requires C.O. battery plus loop resistance)	R-T
DIAL PULSE:	10 pulses per second	50 msec Break, 40 msec Make 600 msec between digits	R-T

ENVIRONMENT

	Operation	Storage
TEMPERATURE:	0° to +140°F	-40° to +140°F
HUMIDITY:	0 to 100% (condensing)	0 to 100% (condensing)
ALTITUDE:	0 to 15,000 Feet	0 to 40,000 Feet

DIMENSIONS*

Height	Width	Depth	Weight
7.0 in.	9.2 in.	5.8 in.	4.4 lbs.

These are overall dimensions, measured with the cover closed.

3M DYNATEL SYSTEMS DIVISION
DYNATEL 745 SUBSCRIBER LOOP TESTER
OPERATION

1. GENERAL

1.01 This part describes the general operation of the 745 subscriber Loop Tester, including the functions of the operating keypad and samples of automatic test routines.

1.02 Whenever this part is reissued, the reason(s) will be listed in this paragraph.

1.03 Comments concerning the content or organization of this document, as well as suggestions for improvement are welcomed. Direct comments to:

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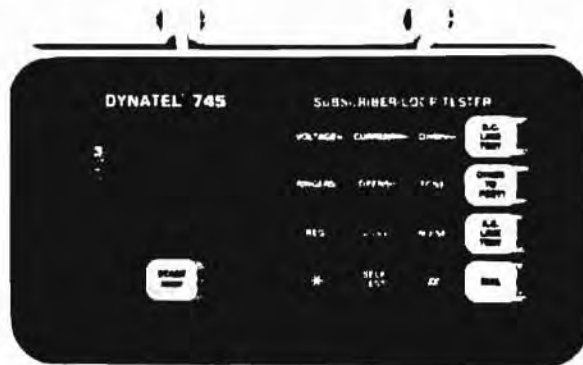


Fig. 2-1—745 SLT Operating Surface

2. START/RESET KEY

2.01 The START/RESET key (see Fig. 2-1) turns the set on and starts a brief self-test sequence which displays the battery status. This key also resets the unit, allowing the operator to exit from any test sequence. In addition, pressing and holding this key will force the unit to turn off after two to four seconds.

Note: Normal turn-off procedure is to push START/RESET and then the pound (#) key.

2.02 Depressing the START/RESET key brings up one of the following displays:

- a) DYNATEL 745
BATTERY OK
- b) CHARGE BATTERY
TONIGHT, PLEASE*
- c) BATTERY LOW
NEEDS CHARGE*

2.03 The display shown in b) appears upon start-up when the set detects diminished battery capacity. In this condition the set has reserve capacity for at least eight hours of continuous operation without affecting accuracy or performance. Depress any function key to proceed with testing.

2.04 The display shown in c) appears upon start-up when the set detects a low battery condition. Under such circumstances

operation accuracy may be affected; no further measurements are permitted. Depress * key to configure set to charge battery.

3. BLUE KEYS

3.01 The blue keys (see Fig. 2-1) select individual test functions and act as a touch keypad for dialing. The following paragraphs describe the keys and their functions.

3.02 VOLTAGE/1—Depressing the VOLTAGE/1 key tests for and indicates the presence of voltage on the line. If hazardous voltage is sensed, an alarm will sound from the speaker and the voltage measured will be indicated on the display. This key also acts as the digit '1' for touch dialing.

3.03 The following demonstrates the procedure for performing a VOLTAGE test.

VOLTAGE TEST SEQUENCE		
STEP	ACTION	VERIFICATION
1	Depress VOLTAGE/1 key.	Display reads: TIP-RING VOLTS = -48.8 V DC *
2	Depress # key.	Display reads: RING-GND VOLTS = -48.8 V DC *
3	Depress # key.	Display reads: TIP-GND VOLTS = 0.0 V DC *
4	Depress * key.	Display reads: TIP-GND VOLTS = 0.0 V AC *
5	Depress # key.	Display reads: TIP-RING VOLTS = 0.0 V AC *
6	Depress # key.	Display reads: RING-GND VOLTS = 0.0 V AC *

Note: Depressing # again recycles the sequence. Depressing * again returns to DC sequence.

3.04 CURRENT/2—When the CURRENT/2 key is depressed, the set applies a 430 ohm short across the pair to simulate an offhook telephone set. Current flow on the loop is measured in milliamps and readings are continuously updated. This key also acts as the digit '2' for touch dialing.

3.05 When the pound (#) key is depressed, station ground resistance is measured and displayed. Resistances less than 25 ohms will be displayed as 'OK' and greater than 25 ohms will be displayed as 'HI'. The following demonstrates this procedure.

CURRENT TEST SEQUENCE		
STEP	ACTION	VERIFICATION
1.	Depress CURRENT/2 key.	Display reads: LOOP CURRENT = -26.2 MILLIAMPS
2.	Depress # key.	Display reads: 0 OHM GND RESISTANCE OK =

3.06 OHMS/3—Depressing the OHMS/3 key measures the insulation resistance between ring and tip, ring and ground, and tip and ground. Results up to 30 megohms are displayed; results of more than 30 megohms will be displayed as '>30 MEGOHMS'. Where resistance is constantly changing, as in the case of swinging of wet faults, ohms measurements are

continuously updated. If resistance changes by more than 20% during testing, the change is signaled by a tone which rises with increasing resistance and falls with decreasing resistance. This key also acts as the digit '3' for touch dialing.

Note: To measure active loop resistance use the REG./7 key. See paragraph 3.14.

3.07 To test pair insulation, remove C.O. battery and ground and measure resistance between each of the three test connections. The ohms circuit will measure resistance in the presence of C.O. battery, but with slightly reduced accuracy. In this situation all measurements would be less than 5000 ohms and would be made up from the following resistive elements:

- a) Tip-Ring Ohms—resistance of tip and ring conductors, C.O. coils and internal resistance of C.O. battery.
- b) Ring-Ground Ohms—resistance of ring conductor, C.O. coil, internal resistance of C.O. battery and ground return resistance.
- c) Tip-Ground Ohms—resistance of tip conductor, C.O. coil and ground return resistance.

Note: Variation in C.O. battery level and presence of power influence will cause these measurements to fluctuate. Also, accumulations of dirt or grime on the test clips or boots may cause the clips to leak resistively. Wash and rinse the boots to restore them to satisfactory condition.

3.08 The following demonstrates the procedure for performing an OHMS test. To recycle the test sequence, depress the # key again at the completion of the first test sequence.

OHMS TEST SEQUENCE

STEP	ACTION	VERIFICATION
1	Depress OHMS/3 key.	Display reads: READING OHMS then: TIP-RING OHMS # >30 MEGOHMS
2	Depress # key.	Display reads: READING OHMS then: RING-GND OHMS # >30 MEGOHMS
3	Depress # key.	Display reads: READING OHMS # then: TIP-GND OHMS # >30 MEGOHMS

Note: When the letters 'C.O.' appear at the end of the second line of the display, C.O. battery is present on the line.

Note: When measuring loop resistance on short cable lengths, self-test set first to zero the measuring circuit.

3.09 RINGERS/4—To count the number of ringers connected to the pair, remove C.O. battery and ground, then depress the RINGERS/4 key. The number of subscriber ringers is displayed in tenths of ringers. Ringer wiring configuration is shown as bridged, wired tip, or wired ring. This key also acts as the digit '4' for touch dialing.

Note: Calibration is based on a type 2500 telephone having a 1.0 ringer equivalence. Different equipment will give different ringer values. It is recommended that a simple chart be made showing the ringer equivalence of commonly used subscriber sets. Use the 745 ringers measurement to characterize subscriber termination whether it be a Bell phone, electronic phone, PBX, etc.

3.10 The following demonstrates a RINGERS test sequence:

RINGERS TEST SEQUENCE

STEP	ACTION	VERIFICATION
1.	Depress RINGERS/4 key.	Display reads: COUNTING RINGERS PLEASE WAIT then: 2.0 RINGERS TIP

Note: The presence of ringer isolators or selective ringing devices will cause ringer value to decrease by 1 or 2 points.

3.11 OPENS/5—To test for opens, depress the OPENS/5 key. This allows selection of cable type, measures capacitance of pair and displays the distance to open in feet. This key also acts as the digit '5' for touch dialing.

3.12 Opens can be measured in the presence of light grounds and crosses. The set will automatically detect when the C.O. side has not been disconnected. It also allows measurement to opens toward the C.O. with one conductor still in service (i.e., C.O. battery on ring with tip open, or grounded tip with ring open). The following demonstrates the use of the OPENS/5 key.

OPENS SEQUENCE

STEP	ACTION	VERIFICATION
1	Depress OPENS/5 key.	Display reads: MEASURE LENGTH then: AIRCORE CABLE = 6000 FT RING *
2.	Depress # key.	Display reads: JELLY FILLED = 5300 FT RING *
3.	Depress # key.	Display reads: 2-PAIR DROP = 4880 FT RING *
4	Depress # key.	Display reads: 5-PAIR DROP = 5000 FT RING *
5.	Depress * key.	Display reads: 5-PAIR DROP = 5000 FT TIP *
6.	Depress * key.	Display reads: 5-PAIR DROP = 4800 FT MUTUAL *

Note: Depress * to recycle measurement sequence. Depress # to recycle cable type.

3.13 TONE/6—Depressing the TONE/6 key applies intermittent or steady 577.5 Hz tone to the pair for conductor identification or coiling resistance faults up to 500 ohms. Loops less than 500 ohms produce loud tone. Loops greater than 500 ohms produce soft tone. This key also acts as the digit '6' for touch dialing. The following demonstrates use of the TONE mode.

Note: In this mode the set will continue to send tone for approximately one hour. When finished with TONE output, manually turn off the set by depressing the RESET key followed by # key to conserve battery power.

TONE SEQUENCE

STEP	ACTION	VERIFICATION
1.	Depress TONE/6 key.	Display reads: SEND TONE # INTERRUPTED *
2.	Depress * key.	Display reads: SEND TONE # CONTINUOUS *
3.	Depress # key.	Display reads: SENDING TONE CONTINUOUS

3.14 REG./7—To detect absence or presence of a loop treatment device, depress the REG./7 key. If such a device is present, it will be identified as a REG (Range Extender with Gain) or Dial Long Line (DLL). This key also acts as the digit '7' for touch dialing. The following demonstrates the use of the REG./7 key.

Note: After the loop treatment test, depress * to display loop resistance to the mainframe and internal C.O. resistance including coils and battery. If O/R is displayed, the loop resistance exceeds the measurement range of the set.

REG. SEQUENCE

STEP	ACTION	VERIFICATION
	Depress REG./7 key	Display reads: CHECKING FOR LOOP AIDS then: REG DETECTED * 74V FROM C.O. or: DIAL LONG LINE DETECTED * or: NO LOOP AIDS DETECTED *
2	Depress * key.	Display reads: LOOP = 700 OHMS C.O. = 400 OHMS

Note: Dial Long Line Detected may be displayed in error with some Step-by-Step offices. Under these circumstances, verify by checking at the C.O.

3.15 LOSS/8—The LOSS/8 key is used to call up a milliwatt or step tone generator, and displays both loss and frequency of the test tone. This key also acts as the digit '8' for touch dialing. The following demonstrates the use of the LOSS/8 key.

Note: Loss and noise tests can be run when an access code is needed by manually dialing the number as described in the charts following para. 4.09.

LOSS SEQUENCE

STEP	ACTION	VERIFICATION
1	Depress LOSS/8 key.	Display reads: READING LOSS then: MW TONE:555-1234 SELECT * DIAL <-#
		Note: If the line does not test as an idle working circuit, the set assumes the tone source has already been connected and will try to measure loss and frequency. This allows for testing on a non-working pair using a portable tone source.
2.	Depress DIAL key.	Display reads: TOUCH TONE # <DIAL> TO DIAL
3	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
4	Depress DIAL key.	Display reads: DIALING 555-1234 DONE then: LOSS AT 1004 HZ IS -7.4 dBm

3.16 NOISE/9—Depress the NOISE/9 key to measure noise metallic and power influence (noise to ground) and display balance. This key also acts as the digit '9' for touch dialing. The following demonstrates the use of the NOISE/9 key.

Note: Loss and noise tests can be run when an access code is needed by manually dialing the number as described on p. 2-4.

NOISE SEQUENCE

STEP	ACTION	VERIFICATION
1	Depress NOISE/9 key.	Display reads: READING NOISE then: QUIET L:555-1234 SELECT * DIAL <-#
		Note: Depress * to select different numbers. Up to four different numbers can be stored in this test routine. Depress DIAL to dial number displayed. Depress # to back up cursor to change a number in the display.
2.	Depress DIAL key.	Display reads: TOUCH TONE # <DIAL> TO DIAL
3.	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
4.	Depress DIAL key.	Display reads: DIALING 555-1234 DONE then: METALLIC NOISE # IS 15.5 dBnC

NOISE SEQUENCE, cont.

STEP	ACTION	VERIFICATION
5.	Depress # key.	Display reads: POWER INFLUENCE = IS 76.5 dBnC
6	Depress # key.	Display reads: BALANCE # IS 61 38

Note: Depressing # recycles the sequence.

3.17 * (Star Key)—Depressing * key shifts between options in a given test step, or displays different test numbers in a dialing sequence.

3.18 SELF TEST/0—When the SELF TEST/0 key is depressed, the set checks internal circuitry, zeroes the set for functional measurements, and configures the set for charging the internal battery. Follow instructions as displayed. This key also acts as the digit '0' for touch dialing.

IMPORTANT: Normal component aging will cause some drift in calibration. Self test the set once a week. During the self-test process the set will automatically recalibrate itself and compensate for any drift.

3.19 # (Pound Key)—Depressing the # (pound key) selects the next step in a given series of tests. When preceded by depressing the RESET key, depressing # key turns the set off.

4. YELLOW KEYS

4.01 The four YELLOW keys on the right side of the keypad (see Fig. 2-1) select automatic test routines, ohms-to-feet conversion, and automatic dialing.

4.02 D.C. LINE TEST—Depressing the D.C. LINE TEST key calls a diagnostic routine to examine the physical characteristics of the pair under test. Voltage, current, resistance and capacitance measurements are made.

4.03 OHMS TO FEET !—Depressing the OHMS TO FEET ! key converts an ohms value to equivalent electrical footage. Any ohms value may be entered with the keypad. The following demonstrates the use of the OHMS TO FEET ! key.

OHMS TO FEET SEQUENCE

STEP	ACTION	VERIFICATION
1	Depress OHMS TO FEET ! key.	Display reads: ENTER R=0010 # CONVERT TO FEET*
2.	Enter value.	The cursor (underline) indicates position of next entry.
3.	Depress * key.	Display reads: 0010 OHMS IS * 149 FT 28 AWG =
4.	Depress # key.	Display reads: 0010 OHMS IS * 236 FT 26 AWG =
5.	Continue depressing # key.	Display will show 24, 22, and 19 AWG.
6.	Depress * key.	Display will allow entry of new resistance (see Step 2 above).

Note: Last ohms measurement made with either OHMS/3 or REG./7 key is automatically transferred to the OHMS TO FEET calculator. When using loop ohms value, divide calculated distance by 2 to obtain distance to strap or short.

4.04 A.C. LINE TEST—Depressing the A.C. LINE TEST key measures the quality of signal received at the test set. Current, loss and noise measurements are made.

4.05 DIAL—The DIAL key allows the operator to select stored numbers, or enter any individual number, either DTMF or dial-pulse, and automatically dial that number.

4.06 When the DIAL key is depressed, one of up to four stored telephone numbers is displayed. The operator can then:

- Select another stored number by depressing *, or
- Enter a new number by moving the cursor (underline) by depressing # and depressing the appropriately numbered blue keys.

4.07 The Dial Mode has an automatic and a manual routine. In the automatic routine, four seven-digit numbers and/or three-digit numbers ending in '-11' can be stored for automatic dialing.

4.08 The manual routine stores four numbers of up to 14 digits. In this routine, the number is displayed to assist in manual dialing. The SLT operator can manually dial a number by depressing the appropriate blue keys.

Note: It is possible to go into a loss or noise test directly from an automatic or manual DIAL sequence by pressing the NOISE or LOSS key following a DIAL sequence.

4.09 The following demonstrate the use of the DIAL key in the automatic and manual routines.

DIAL AUTOMATIC ROUTINE

STEP	ACTION	VERIFICATION
1	Depress DIAL key	Display reads: NUMBER: 555-1234 SELECT * DIAL <-#
2	Depress * key.	Display reads: NUMBER: 000-0000 SELECT * DIAL <-#
3	Enter Number.	The cursor (underline) indicates position of next entry.
4	Depress DIAL key.	Display reads: TOUCH TONE # <DIAL> TO DIAL

NOTE: Depressing # at this time advances to the Manual Routine.

6	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
7	Depress DIAL key.	Display reads: DIALING 555-1234 DONE

DIAL MANUAL ROUTINE

STEP	ACTION	VERIFICATION
1	Depress DIAL key.	Display reads: NUMBER: 555-1234 SELECT * DIAL <-#
2	Depress * key.	Display reads: NUMBER: 000-0000 SELECT * DIAL <-#
3	Depress DIAL key.	Display reads: TOUCH TONE # <DIAL> TO DIAL
4	Depress # key.	Display reads: DIAL PULSES # <DIAL> TO DIAL
5	Depress # key.	Display reads: MANUAL T-TONE # <DIAL> TO DIAL
5	Depress # key.	Display reads: MANUAL PULSES # <DIAL> TO DIAL

NOTE: Depress # again to recycle dial mode selection.

7	Depress DIAL key.	Display reads: ENTER DIGITS +! 415-5551234
8	Depress OHMS TO FEET ! key.	Display reads: ENTER DIGITS +! 415-5551234!

Number entry ends with an exclamation mark (!) and the number is sent.

5. SAMPLE AUTOMATIC TEST ROUTINES:

5.01 The Dynatel 745 SLT has two fully automatic test routines. Diagnostic testing proceeds through a series of tests and displays test results or probable cause of trouble when appropriate.

A. D.C. LINE TESTS

5.02 The D.C. LINE TEST looks for physical trouble on the line. The following are sample sequences to find the condition indicated. At the end of a sequence, an exclamation mark (!) will appear in the final display.

D.C. LINE TEST—LINE BUSY

STEP	ACTION	VERIFICATION
1	Depress D.C. LINE TEST key.	Display reads: D.C. LINE TEST then: LINE TESTS BUSY CHK FOR SPEECH *
2	Depress * key.	Display reads: IF NO SPEECH ROH OR LO SHORT

D.C. LINE TEST—LINE IDLE—TESTS OK

STEP	ACTION	VERIFICATION
1	Depress D.C. LINE TEST key.	Display reads: D.C. LINE TEST then: LINE IDLE VOLTAGE OK *
2	Depress * key.	Display reads: NO LOOP AIDS DETECTED *
3	Depress * key.	Display reads: 15 OHM GND RESISTANCE OK *
4	Depress * key.	Display reads: LOOP CURRENT OK -31.2 MA DC *
5	Depress * key.	Display reads: IF STATIC HEARD HIT * ELSE #
6	Depress * key.	Display reads: LINE TEST OK *
7	Depress * key.	Display reads: TO COUNT RINGERS DISCONNECT C.O.*
8	Disconnect C.O. and depress * key.	Display reads: HIT RINGERS KEY TO TEST

D.C. LINE TEST—LINE IDLE—TESTS MARGINAL

STEP	ACTION	VERIFICATION
1	Depress D.C. LINE TEST key.	Display reads: D.C. LINE TEST then: LINE IDLE VOLTAGE OK *
2	Depress * key.	Display reads: NO LOOP AIDS DETECTED *
3	Depress * key.	Display reads: 24 OHM GND RESISTANCE OK *
4	Depress * key.	Display reads: LOOP CURRENT LOW -20.2 MA *
5	Depress * key.	Display reads: LOOP = 1750 OHMS C.O. = 400 OHMS *
6	Depress * key.	Display reads: LOOP = 1750 OHMS WITHIN RZ 18 *

Note: When Loop current is below 23 milliamps, loop resistance values are only approximate. This fact is indicated by an added statement in the display which tells the operator that the loop resistance is within a resistance zone (RZ). The zones have a number associated with them which indicates that the loop resistance is between certain values. The zones and corresponding loop resistances are in the table below.

RZ = 13 Loop resistance less than 1300 ohms
RZ = 16 Loop resistance from 1300 ohms to 1600 ohms
RZ = 18 Loop resistance from 1600 ohms to 1800 ohms
RZ = 28 Loop resistance from 1800 ohms to 2800 ohms

STEP	ACTION	VERIFICATION
7	Depress * key.	Display reads: CHK OPERATION OF LOOP AID *

Note: At this point, either there is no loop aid, a faulty loop aid, or a resistant fault on the pair under test. To isolate the condition, check other pairs for loop treatment and add treatment if missing or faulty. If current on other pairs is acceptable without treatment, a resistance fault is indicated. Sectionalize to locate.

8	Depress * key.	Display reads: IF STATIC HEARD HIT * ELSE #
---	----------------	--

D.C. LINE TEST—LINE IDLE, cont.

STEP	ACTION	VERIFICATION
9	Depress # key.	Display reads: LINE TESTS MARGINAL *
	Depress * key	Display reads: DISCONNECT C.O. CHK USING OHMS *
11	Depress * key	Display reads: TO COUNT RINGERS DISCONNECT C.O. *
12	Disconnect C.O. and depress * key	Display reads: HIT RINGERS KEY TO TEST

D.C. LINE TEST—LINE VACANT

STEP	ACTION	VERIFICATION
1	Depress D.C. LINE TEST key	Display reads: D.C. LINE TEST then: TIP-RING VOLTS 0.0 V DC LOW *
2	Depress * key	Display reads: LINE FAULTY OR NOT POTS LOOP *
3	Depress * key	Display reads: LINE TESTS AS VACANT PAIR *
4	Depress * key.	Display reads: READING OHMS then: INSULATION GOOD NO SHORT OR GND *
5	Depress * key	Display reads: MEASURE LENGTH AIRCORE CABLE *
6	Depress * key.	Display reads: LINE OPEN AT 380 FEET

Note 1: When 'LINE OPEN AT' is displayed, tip and ring are balanced within 5%. When one conductor is shorter than the other by more than 5%, the display will read 'TIP OPEN AT' or 'RING OPEN AT'

Note 2: If an induced AC voltage greater than 2 VAC is detected, the display will read AC INDUCTION. USE MANUAL OPEN *. Pressing the * key will exit to step 7 below. To measure the distance to the open, it will be necessary to exit the D.C. line test mode and perform an opens test using the OPENS/5 key (see 3-11)

Depress * key.	Display reads: COUNTING RINGERS PLEASE WAIT. then: NO RINGERS DETECTED
----------------	---

D.C. LINE TEST—LINE FAULTED

STEP	ACTION	VERIFICATION
1	Depress D.C. LINE TEST key.	Display reads: D.C. LINE TEST then: TIP-RING VOLTS 39.6 V DC LOW *
2	Depress * key.	Display reads: LINE FAULTY OR NOT POTS LOOP *
3	Depress * key.	Display reads: NO LOOP AIDS DETECTED *
4	Depress * key.	Display reads: 500 OHM GND RESISTANCE BAD *
5	Depress * key.	Display reads: LOOP CURRENT LOW -3.5 MA *
6	Depress * key.	Display reads: LOOP = 14915 OHMS C.O. = 426 OHMS *
7	Depress * key.	Display reads: LOOP = 14915 OHMS POOR CONTINUITY *
8	Depress * key.	Display reads: CHK USING OPENS FOR HI RES CONN *
9	Depress * key.	Display reads: CHK OPERATION OF LOOP AID *
10	Depress * key.	Display reads: LINE TEST FAILED *
11	Depress * key.	Display reads: DISCONNECT C.O. CHK USING OHMS *
	Depress * key.	Display reads: TO COUNT RINGERS DISCONNECT C.O. *
13	Disconnect C.O. and	

D.C. LINE TEST—LINE FAULTED, cont.

STEP	ACTION	VERIFICATION
	depress * key.	Display reads: HIT RINGERS KEY TO TEST

B. A.C. LINE TESTS

5.03 The A.C. Line Test measures the quality of the signal received at the test termination. Following are sample sequences for various line conditions indicated. When a sequence terminates, an exclamation mark (!) will appear in the final display.

A.C. LINE TEST—LOSS ACCEPTABLE—CURRENT OK

STEP	ACTION	VERIFICATION
1	Depress A.C. LINE TEST key.	Display reads: A.C. LINE TEST then: LINE IDLE VOLTAGE OK *
2	Depress * key	Display reads: LOOP CURRENT OK -31.1 MA DC *
3	Depress * key	Display reads: MW TONE ? * STEP TONE ? *
NOTE: Depressing * at this point advances to the Loss Routine.		
4	Depress * key.	Display reads: MW TONE. 555-1234 SELECT * DIAL <- =
NOTE: Depress * to select different numbers. Up to four different numbers can be stored in the test routine. Depress DIAL to dial number displayed. Depress = to back up cursor to change a number in the display.		
5	Depress DIAL key.	Display reads: TOUCH TONE * <DIAL> TO DIAL
6	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
7	Depress DIAL key.	Display reads: DIALING 555-1234 then: PRESS * WHEN TONE PRESENT
8	Depress * key.	Display reads: LOSS AT 1004 Hz IS -4.6 dBm
9	Depress * key.	Display reads: LOSS -4.6 dBm ACCEPTABLE *
10	Depress * key.	Display reads: NO CURRENT OR LOSS PROBLEM *
11	Depress * key.	Display reads: STATION GND OK UNDER 25 OHMS *

Note: Depressing * at this point advances to the Noise Routine.

A.C. LINE TEST—LOSS ACCEPTABLE—CURRENT LOW

STEP	ACTION	VERIFICATION
1	Depress A.C. LINE TEST key.	Display reads: A.C. LINE TEST then: LINE IDLE VOLTAGE OK *
2	Depress * key.	Display reads: LOOP CURRENT LOW -21.4 MA DC *
3	Depress * key.	Display reads: MW TONE * STEP TONE *
4	Depress * key.	Display reads: MW TONE. 555-1234 SELECT * DIAL <- =
Note: Depress * to select different numbers. Up to four different numbers can be stored in this test routine. Depress DIAL to dial number displayed. Depress = to back up cursor to change a number in the display.		
5	Depress DIAL key.	Display reads: TOUCH TONE * <DIAL> TO DIAL
6	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
7	Depress DIAL key.	Display reads: DIALING 555-1234 then: PRESS * WHEN TONE PRESENT

LOSS ACCEPTABLE—CURRENT LOW, cont:

STEP	ACTION	VERIFICATION
8	Depress * key.	Display reads: LOSS AT 1004 Hz IS -7.1 dBm then: LOSS -7.1 dBm ACCEPTABLE *
9	Depress * key	Display reads: LO MA SUGGEST POOR CONNECTION *
10	Depress * key	Display reads: TO VERIFY CHK OTHER PAIRS *
11	Depress * key	Display reads: SECTIONALIZE TO LOCATE *
12	Depress * key.	Display reads: FIX CURRENT/LOSS PROBLEMS FIRST *

Note: Depressing * at this point advances to the Noise Routine.

A.C. LINE TEST—LOSS UNACCEPTABLE—CURRENT OK

STEP	ACTION	VERIFICATION
1	Depress A.C. LINE TEST key.	Display reads: A.C. LINE TEST then: LINE IDLE VOLTAGE OK *
2	Depress * key.	Display reads: LOOP CURRENT OK -26.5 MA DC *
3	Depress * key	Display reads: MW TONE STEP TONE #
4	Depress * key	Display reads: MW TONE: 555-1234 SELECT * DIAL <-#
5	Depress DIAL key	Display reads: TOUCH TONE <DIAL> TO DIAL #
6	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
7	Depress DIAL key.	Display reads: DIALING 555-1234 then: PRESS * WHEN TONE IS PRESENT
8	Depress * key.	Display reads: LOSS AT 1004 HZ IS -10.4 dBm then: LOSS -10.4 dBm UNACCEPTABLE *
9	Depress * key.	Display reads: PROBLEM AT STA OR NETWORK *
10	Depress * key.	Display reads: REMOVE STA SIDE REPORT TEST *
11	Depress * key	Display reads: IF LOSS DROPS BY MORE THAN 0.5dB *
12	Depress * key.	Display reads: PROBLEM IS ON STATION SIDE *
13	Depress * key.	Display reads: IF NOT, CHK FOR MISSING LOADS *
14	Depress * key.	Display reads: LOADED BRG TAP EXCESS BRG TAP *

NOTE: Repeat test with steptone source to confirm transmission problem (see A.C. LINE TEST—Acceptable Slope and A.C. LINE TEST—Loaded Bridge Tap Condition).

15	Depress * key.	Display reads: FIX CURRENT/LOSS PROBLEMS FIRST *
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Note: Depress * to advance to Noise routine.

A.C. LINE TEST—LOSS UNACCEPTABLE—CURRENT LOW

STEP	ACTION	VERIFICATION
1	Depress A.C. LINE TEST key.	Display reads: A.C. LINE TEST then: LINE IDLE VOLTAGE OK *
2	Depress * key.	Display reads: LOOP CURRENT OK -21.9 MA DC *
3	Depress * key.	Display reads: MW TONE STEP TONE #

LOSS UNACCEPTABLE—CURRENT LOW, cont:

STEP	ACTION	VERIFICATION
4	Depress * key.	Display reads: STEP T. 555-1234 SELECT * DIAL <-#
Note: Depress * to select different numbers. Up to four different numbers can be stored in this test routine. Depress DIAL to dial number displayed. Depress # to back up cursor to change a number in the display.		
5	Depress DIAL key.	Display reads: TOUCH TONE <DIAL> TO DIAL #
6	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
7	Depress DIAL key.	Display reads: DIALING 555-1234 then: PRESS * WHEN TONE IS PRESENT
8	Depress * key.	Display reads: LOSS AT 1004 HZ IS -10.4 dBm then: LOSS -10.4 dBm UNACCEPTABLE
9	Depress * key.	Display reads: LOOP TOO LONG REG REQUIRED *
10	Depress * key.	Display reads: FIX CURRENT/LOSS PROBLEMS FIRST *

Note: Depress * to advance to Noise routine.

A.C. LINE TEST—ACCEPTABLE SLOPE

STEP	ACTION	VERIFICATION
1	Depress A.C. LINE TEST key.	Display reads: A.C. LINE TEST then: LINE IDLE VOLTAGE OK *
2	Depress * key.	Display reads: LOOP CURRENT OK -28.9 MA DC *
3	Depress * key.	Display reads: MW TONE ? STEP TONE ? #
4	Depress # key.	Display reads: STEP T. 555-1234 SELECT * DIAL <-#
Note: Depress * to select different numbers. Up to four different numbers can be stored in this test routine. Depress DIAL to dial number displayed. Depress # to back up cursor to change a number in the display.		
5	Depress DIAL key.	Display reads: TOUCH TONE <DIAL> TO DIAL #
6	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
7	Depress DIAL key.	Display reads: DIALING 555-1234 then: PRESS * WHEN TONE PRESENT
8	Depress * key.	Display reads: LOSS AT 400 HZ IS -4.2 dBm then: LOSS AT 1004 HZ IS -6.1 dBm then: LOSS AT 2800 HZ IS -11.4 dBm then: SLOPE = 5.3 dB ACCEPTABLE *
9	Depress * key.	Display reads: NO LOADING PROB RESTORE SERVICE

A.C. LINE TEST—LOADED BRIDGE TAP CONDITION

STEP	ACTION	VERIFICATION
1	Depress A.C. LINE TEST key.	Display reads: A.C. LINE TEST then: LINE IDLE VOLTAGE OK *
2	Depress * key.	Display reads: LOOP CURRENT OK -28.9 MA DC *
3	Depress * key.	Display reads: MW TONE STEP TONE #

LOADED BRIDGE TAP CONDITION, cont:

STEP	ACTION	VERIFICATION
4	Depress # key.	Display reads: STEP T: 555-1234 SELECT * DIAL <-#
	<i>Depress * to select different numbers. Up to four different numbers can be stored in the test routine. Depress DIAL to dial number displayed. Depress # to back up cursor to change a number in the display.</i>	
5	Depress DIAL key	Display reads: TOUCH TONE = <DIAL> TO DIAL
6	Depress DIAL key	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
7	Depress DIAL key.	Display reads: DIALING 555-1234 then: PRESS * WHEN TONE PRESENT
9	Depress * key	Display reads: LOSS AT 400 HZ IS -5.2 dBm then: LOSS AT 650 HZ IS -7.5 dBm then: LOSS AT 1000 HZ IS -16.5 dBm then: LOSS AT 1300 HZ IS -12.0 dBm then: LOSS AT 1700 HZ IS -9.1 dBm then: LOSS AT 2000 HZ IS -9.2 dBm then: LOSS AT 2300 HZ IS -10.4 dBm then: LOSS AT 2800 HZ IS -14.8 dBm then: LOSS AT 3000 HZ IS -13.1 dBm then: SLOPE = 1.7 dB ACCEPTABLE *
	Depress * key	Display reads: DTMF SIGNALING LIMIT EXCEEDED *
10.	Depress * key.	Display reads: LOADED BRG TAP CHK RECORDS *
11	Depress * key	Display reads: SECTIONALIZE TO LOCATE PROBLEM !

C. AUTO-NOISE ROUTINES

5.04 Auto-Noise Routine—once loss is found acceptable, the A.C. Line Test routine enters a noise routine. Following are sample noise sequences to find the condition indicated. When a sequence terminates, an exclamation mark (!) will appear in the final display. Due to display constraints, noise values are displayed in units of dB, although the set actually is measuring dBrnC units.

IMPORTANT: All examples assume measurements are made from the protector or drop splice with the 745 bridged directly across the line. If measurements are made in the network for sectionalizing, the 745 must be connected via a bridging transformer for accurate noise measurements.

NOISE ROUTINE—NOISE—ACCEPTABLE

STEP	ACTION	VERIFICATION
1	Depress * key.	Display reads: QUIET L:555-1234 SELECT * DIAL <-#
	<i>Note: Depress * to select different numbers. Up to four different numbers can be stored in the test routine. Depress DIAL to dial number displayed. Depress # to back up cursor to change a number in the display.</i>	
	Depress DIAL key.	Display reads: TOUCH TONE # <DIAL> TO DIAL
	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS

NOISE ROUTINE—ACCEPTABLE, cont:

4.	Depress DIAL key	Display reads: WAIT FOR QUIET LINE THEN PUSH *
5.	Depress * key.	Display reads: NOISE = 15.2 dB ACCEPTABLE *
6.	Depress * key.	Display reads: PWR INF = 75.2 dB ACCEPTABLE *
7	Depress * key.	Display reads: BALANCE = 50.0 dB ACCEPTABLE *
8.	Depress * key.	Display reads: NOISE ACCEPTABLE RESTORE SERVICE *
9.	Depress * key.	Display reads: STEP TONE? * END *

NOISE ROUTINE—POWER INFLUENCE HIGH

STEP	ACTION	VERIFICATION
1.	Depress * key	Display reads: QUIET L:555-1234 SELECT * DIAL <-#
	<i>Note: Depress * to select different numbers. Up to four different numbers can be stored in this test routine. Depress DIAL to dial number displayed. Depress # to back up cursor to change a number in the display.</i>	
2.	Depress DIAL key.	Display reads: TOUCH TONE = <DIAL> TO DIAL
3.	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
4	Depress DIAL key	Display reads: WAIT FOR QUIET LINE THEN PUSH *
5.	Depress * key.	Display reads: NOISE = 18.3 dB ACCEPTABLE *
6.	Depress * key.	Display reads: PWR INF = 92.0 dB UNACCEPTABLE *
7	Depress * key.	Display reads: BALANCE = 73.7 dB ACCEPTABLE *
8.	Depress * key.	Display reads: POOR BOND OR GND CHECK FOR *
9.	Depress * key.	Display reads: SHIELD BONDS CABLE GROUNDS *
10.	Depress * key.	Display reads: SECTIONALIZE TO LOCATE *
11.	Depress * key.	Display reads: USE BRDG XFORMER TO TST AT XBOX *
12.	Depress * key.	Display reads: STEP TONE? * END *

NOISE ROUTINE—NOISE-METALLIC HIGH

STEP	ACTION	VERIFICATION
1	Depress * key.	Display reads: QUIET L:555-1234 SELECT * DIAL <-#
	<i>NOTE: Depress * to select different numbers. Up to four different numbers can be stored in this test routine. Depress DIAL to dial number displayed. Depress # to back up cursor to change a number in the display.</i>	
2.	Depress DIAL key.	Display reads: TOUCH TONE # <DIAL> TO DIAL
3.	Depress DIAL key.	Display reads: PRESS DIAL WHEN DIAL TONE SOUNDS
4.	Depress DIAL key.	Display reads: WAIT FOR QUIET LINE THEN PUSH *
5.	Depress * key.	Display reads: NOISE = 31.5 dB UNACCEPTABLE *
6.	Depress * key.	Display reads: PWR INF = 78.0 dB ACCEPTABLE *
7	Depress * key.	Display reads: BALANCE = 46.5 dB UNACCEPTABLE *
8.	Depress * key.	Display reads: CKT UNBALANCED SECTIONALIZE *
9.	Depress * key.	Display reads: PROB IN STATION CABL PLT OR CO *

NOISE ROUTINE—METALLIC HIGH, cont.

10.	Depress * key	Display reads: REPEAT TEST WITH STA. SIDE OPEN *
11.	Depress * key	Display reads: A DROP OF 3dB OR MORE IN NOISE *
12.	Depress * key	Display reads: LOCATES TROUBLE ON DISCONN SIDE *
13.	Depress * key	Display reads: IF STILL UNBAL RETST AT ACCESS *
14.	Depress * key	Display reads: USE BRDG XFORMER TO TST AT XBOX *
15.	Depress * key	Display reads: STEP TONE ? * END #

6. CARE AND MAINTENANCE

6.01 Operator maintenance of the 745 Subscriber Loop Tester is limited to battery charging and minor care.

A. Battery Charging

6.02 Battery charging can be done on a daily or weekly basis or only when the set displays 'CHARGE TONIGHT, PLEASE'. Daily charging is recommended during periods of severe cold weather operation.

6.03 To charge battery, connect a 12-15V DC supply to the tip and ring test clips. Depress SELF TEST key followed by # key and * key. This will configure the set for charging and display the battery voltage together with the charging current. Too much or too little charge will automatically be indicated on the display. Generally, the battery can be fully charged during a 12-hour period or overnight.

6.04 If the unit cannot be started up for a normal battery charge cycle, or if a rapid charge is desired, there is an alternate charging scheme: connect the Tip and Ring test leads to a 12 to 15VDC source (a car or truck battery is ideal) and invert the unit (place it on a horizontal surface with the panel facing down). After about three seconds a soft click should be heard from the unit, indicating that the alternate charge relay has picked up. At this point the set can be placed back in an upright position, and the set should respond normally to the START/RESET key. If it does not respond, there is an electronic malfunction which will require that the set be returned for servicing. If the set does respond, continue the charge. One hour of charging should provide enough energy for a full day's use. Eight hours of charging will completely recharge a dead battery.

Note: 1) In this mode, the unit does not monitor the charging voltage; make sure the voltage source has the proper voltage, as excessive voltage could cause damage to the charge circuit. 2) Charging in this alternate mode is not automatically terminated by the unit. Use this charging mode for eight hours maximum; repeated use of the alternate charging for extended periods may decrease battery life. If additional charging is desired, shift to a normal charge by disconnecting the power source momentarily, reconnecting, and following the charge procedure in paragraph 6.03.

B. Cleaning

6.05 As the set is water-resistant, both the case and operating surface may be cleaned with a damp cloth and mild detergent.

Note: The use of solvents may affect faceplate seal integrity and is not recommended.

C. Cold Weather Operation

6.06 Prolonged operation (more than 1 hour) or storage at temperatures below freezing will affect battery supply voltage and capacity which may cause a low battery condition to be displayed. To avoid this situation, recharge the test set nightly at room temperature.

6.07 Storage at subzero temperatures (below 0° F) for prolonged periods may cause the set to become temporarily inoperable. To restore it to its operating state, warm the test set at room temperature for 2 to 3 hours. If it still fails to turn on, attach the test leads to a 12-15V DC supply to recharge the battery.

6.08 When using the set close to the minimum operating temperature (0° F), it is normal for the liquid crystal display to be slow to update.

D. Hot Weather Operation

6.09 Prolonged exposure of the display to direct sunlight may cause a reduction in character contrast. To avoid this condition, keep the lid closed between measurement operations. When using the 745 at high temperatures and in direct sunlight, the liquid crystal display may turn completely black if the liquid crystal heats to over 140° F. This condition is completely reversible and the display will return to normal as soon as it is cooled to less than 140° F. Placing the unit in the shade should cool the 745 sufficiently to prevent or cure this situation.

E. Replacing Damaged Test Leads

6.10 If the test leads become damaged, a new set can be installed by removing the nylon strain relief clamp located in the storage compartment. See Fig. 2-2. This will require the use of a phillips screwdriver and a 5/16" open-end wrench. Make a note which color lead goes to which socket on the connector. It is important that the new test leads be inserted into the correct socket on the connector. The damaged test leads can now be removed by pulling on each lead individually until it pops out of the connector. Needle nose pliers may be helpful. After the old test leads have been removed, the new test leads are individually inserted into the correct socket as noted before. After all leads are connected, run self-test (opens and ohms).

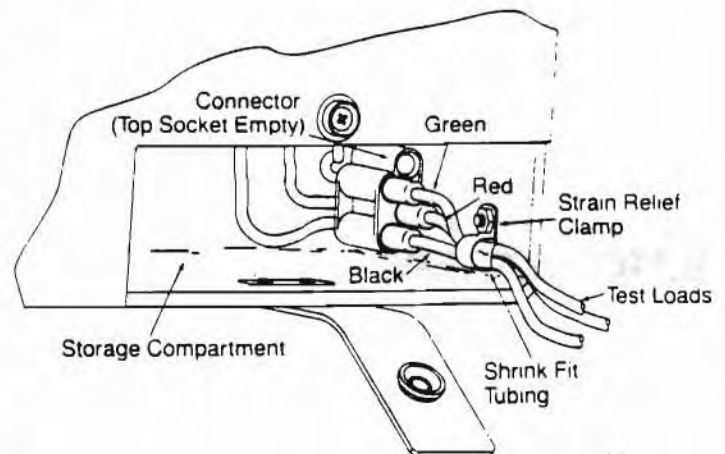


Figure 2-2

3M DYNATEL SYSTEMS DIVISION
DYNATEL 745 SUBSCRIBER LOOP TESTER
APPENDIX

Generally Accepted Criteria
for Plain Old Telephone Service (POTS)

Parameter	Acceptable	Marginal	Unacceptable
Loop Current ma	23 ⁻	20-23 ⁻	20 ⁺
Circuit Loss dBm	8.5 ⁺	-	8.5 ⁺
Circuit Noise dBrnC	20	20-30	30
Power Influence dBrnC	80	80-90	90
Balance dB	50	50-60	50
Station Ground Ohms	25	-	25
Slope dB	-7.5	-	7.5

Parameter	Insulation Good	Light Fault (Service Affected)**	Heavy Fault (Out of Service)
Insulation Resistance	3.3 MOhms	2.8 KOhms	3.3 MOhms 2800 Ohms

⁻These are negative values.

⁺ 18-20 ma acceptable for emergency service only

** Lines having good insulation but equipped with ringer isolators or selective ringing devices will test as having light faults on tip and ring.

NOTE: means more than
means more than or equal to
means less than
means less than or equal to

Notes on AC line Analysis Procedures

1. Loop current and circuit loss work together. When loop current approaches -23 ma the circuit loss should be approximately -8.0 dBm. If the loop current is low and the circuit loss is less than -8.0 dBm, the problem is probably a defective loop aid. If the loop current is good and the circuit loss is high, the problem is either bridged tap or incorrect loading. If both loop current and circuit loss are bad, the problem is incorrect resistance zoning. When circuit loss exceeds -8.5 dBm, the actual measured loss should be compared with an estimated measured loss based on loop make-up. If they differ significantly, dial up step tone generator and make frequency run to check loading. If both actual and estimated loss exceed -8.5 dBm and are approximately the same, install a VF repeater to decrease the loss.
 2. Noise and Power influence work together. If noise is high and power influence is low, the problem most likely is defective pair. If power influence is high, the problem is an open shield or missing ground.
 3. For touch dialing problems, dial up step tone generator and make frequency run to check for loaded bridge tap.
 4. If in doubt, measure additional pairs. If other pairs are good, your problem is a single bad pair. If other pairs read defective as the one you're working on, the problem is in cable or complement.
- Make out Field Repair Tickets accurately. Report whole cable or complement problems to transmission team.

6. For 2-party lines, a missing ringer isolator at one party causes noise to the other party. Ringer isolators must be placed at both parties.

7. Unacceptable Balance—When noise and power influence are shown as acceptable, but the balance reading is not, as in this example:

Noise = 19.3 dBrnC (OK)
Power influence = 68.2 dBrnC (OK)
Balance = 48.9 dBrnC (unacceptable)

the unacceptable balance reading is a clue that there may be noise problems during peak power periods when power influence will be higher than at the time the service call is made. If noise was the subscriber's complaint, then balance is the cause of problem; if the complaint was not related to noise, the low balance may not be a problem. Noise caused by balance is a common cause of multiple service calls. The noise and power influence levels are more likely to be acceptable at the time of the service call than when the subscriber is at home and using the phone during morning and evening peak power periods. An unacceptable balance reading is the only clue in this situation.

GLOSSARY OF TERMS

Balance: The amount of cancellation of current flowing along tip and ring conductors. Currents that are not cancelled are heard by the subscriber as noise metallic. Balance in dB can be calculated by the formula: BALANCE = POWER INFLUENCE minus CIRCUIT NOISE.

Bulge: The shape of the frequency loss characteristic of a subscriber's line. With loading problems present, the normally smooth loss/frequency curve exhibits a bulge in the middle of the voice frequency band.

C-Message Weighting: This filtering makes measurements of noise more like the response of the human ear to various frequencies over a telephone circuit. Sensitivity of the ear drops at frequencies below 800 Hz, and above 2500 Hz.

Decibel (dB): A unit for measuring the relative strength of a signal parameter such as power or voltage. Normally used in measuring the loss or gain of power in a device or circuit.

dBm: A measurement of the power of a signal received above a reference power of 1 milliwatt (10⁻³ watts).

dBrnC: (dB reference noise): The reference for noise measurement was determined to be a level equivalent to a tone at -90 dBm. Therefore, 0 dBrnC = -90 dBm and 0 dBm = 90 dBrnC.

dBrnC: The dBrnC measured with C-message weighting.

DLL: Dial Long Line is a loop treatment device that boosts the loop current.

Flat Weighting: (with maximum frequency specified such as 200 Hz—15 KHz): this filtering is used for analyzing noise or loss which may affect the performance of circuits that do not involve voice transmission, such as data circuits.

Ground Resistance: The resistance between the subscriber protector ground and C.O. ground. Within the telephone plant, resistance up to 25 ohms is considered acceptable.

Line Loss (Circuit Loss): The measurement of power loss expressed in dBm measured with a flat weighting over the voice frequency band.

Loading, Cable: Adding inductance (load coils) at specific intervals along a cable in order to reduce amplitude distortion and improve frequency response over the desired band width. This compensates for the effect of distributed capacitance between conductors in a cable which tends to degrade transmission as the line length is increased.

Loop Current: The measurement of current required to properly operate C.O. equipment and station apparatus located at the subscriber premises. This measure is expressed in milliamperes (ma). Minimum acceptable loop current is considered to be 23 ma.

Loop Treatment (Reg., DLL): C.O. extension equipment placed on a pair to overcome excessive line loss.

Noise: Electrical signals which interfere with normal transmission of information, such as voice and data.

Noise Metallic (Nm): Noise measured across the tip and ring of a circuit which is actually heard by the customer on the line. Same as circuit noise and is measured in units of dBnC.

Power influence (PI): Noise measured between ground and the tip and ring conductors tied together. The subscriber does not hear the noise-to-ground. However, the amount of PI that exists will affect the amount of noise metallic which the subscriber hears. Same as noise-to-ground (Ng) and measured in dBnC.

REG (Range Extender with Gain): Loop treatment device which boosts the C.O. battery voltage and amplifies the AC speech signal.

Ringers: The ringer circuit of a subscriber telephone set. Ringers are wired tip, wired ring, or bridged. Measurements are made in tenths of a ringer to allow identification of nonstandard equipment on the premises.

ROH: Acronym for Receiver Off Hook condition.

Slope: The difference in attenuation between 1004 Hz and 2804 Hz. Measured in decibels, slope is a measurement of the frequency response of a pair.

Recommended A.C. Line Analysis Procedures

MEASUREMENTS	ADDITIONAL TEST	CAUSE	REPAIR
Good Current ($\geq 23\text{mA}$) Unacceptable Loss ($\leq 3.5\text{dBm}$)	Measure additional pairs 1) All pairs measure the same	Complement problem bridged tap morose load	Make out ticket repair ticket. Report to trans. team inform customer more work required
	2) All other pairs measure good.	Pair problem	Make out ticket Change to good pair
Good Current ($\geq 23\text{mA}$) Unacceptable Slope ($\leq 7.5\text{dBm}$) OR	Measure additional pairs 1) All pairs measure the same	Complement problem	Make out ticket inform customer more work needed
	2) All other pairs measure good	Pair problem	Make out ticket Report to trans. team. If customer has reported touch tone dialing problem replace with rotary unit. bridged tap removed
Unacceptable Noise ($\leq 20\text{dBnC}$) Acceptable Power Influence ($\leq 80\text{dBnC}$) Unacceptable Balance ($\leq 60\text{dB}$)	Measure additional pairs 1) All pairs measure the same	Complement problem. Wet cable Bad splice	Refer to cable repair. Notify customer more work required
	2) All other pairs acceptable Disconnect I/W	Pair problem Trouble inside	Change pair inform customer of I/W or set problem
1) Dedicated Line	a) Readings acceptable		
	b) Readings still unacceptable	Bad pair/drop	Replace/repair pair/drop
2) Party Line	1) Check for ringer isolator.	Missing or defective ringer isolator	Place ringer isolator
	2) Go to other party location	Missing or defective ringer isolator	Place ringer isolator
Unacceptable Noise ($\leq 20\text{dBnC}$) Unacceptable or Marginal Power Influence ($\leq 80\text{dBnC}$) Acceptable Balance ($\leq 60\text{dB}$)	Check for good ground at protector and work-out terminal	Open shield Missing ground	Inform customer more work required. Make out ticket. Report to trans. team

Recommended A.C. Line Analysis Procedures

MEASUREMENTS	ADDITIONAL TEST	CAUSE	REPAIR
Low Current ($\geq 23\text{mA}$) Acceptable Loss ($\leq 3.5\text{dBm}$)	1) Good Ohms reading Good Balance Good MLT TEST	Defective REG or power supply	Check for REG
	2) Marginal DC measurements Poor Balance	Defective pair	Isolate, repair or change REG.
Low Current ($\geq 23\text{mA}$) Unacceptable Loss ($\leq 3.5\text{dBm}$)	Measure additional pairs 1) All pairs measure the same	Incorrect resistance zone	Inform customer more work needed. Make out ticket. Report to trans. team
	2) All other pairs measure good.		Check for REG. Have REG. assigned.

3M DYNATEL SYSTEMS DIVISION
SERVICE, REPAIR, AND WARRANTY POLICIES

1. INTRODUCTION

1.01 This section describes the Dynatel Systems (hereinafter may also be referred to as the Seller) service, repair, and warranty policies. It is intended for use as a procedural reference in the event the need for service or repair should arise, and also outlines limited warranty specifics.

2. RETURNS

2.01 All items returned to Dynatel Systems must be accompanied by a Material Return Authorization (MRA) number, which may be obtained by contacting the Dynatel Systems Repair Department, as specified below, that services your particular product. After receiving an MRA number, the equipment should be shipped prepaid to:

All APC And Dynatel™ Products:

3M Dynatel Systems Division
Attn: Repair Department
PO BOX 2963
11705 Research Blvd.
Austin, TX 78769-2963
512/258 1651 or
800/531 5308
TWX 910 874 2020

All Dynatel Products And APC Construction Products:

3M Dynatel Systems Division
Attn: Repair Department
6600 Jimmy Carter Blvd.
Norcross, Georgia 30071
404/447 7145

Note: Both shipping carton and packing list must reference the MRA number.

2.02 Enclosed with the equipment should be a statement giving the reasons for return as well as the name, address and telephone number of the person to whom the unit is to be returned and billed.

3. REPAIRS

3.01 **WARRANTY ON REPAIRED EQUIPMENT:** All repair of Dynatel Systems instruments, except the APC Models 1301 and 1303, are warranted to be free from defects in material and workmanship for a period of ninety (90) days, commencing on the date of shipment to the buyer. APC™ Models 1301, 1303 and all other Dynatel Systems product repairs are warranted for thirty (30) days. Dynatel Systems' sole and exclusive obligations and liabilities under these warranties are and shall be limited to issuance of credit for or repair or replacement of any goods or parts which are proved to be other than as warranted; and Dynatel Systems shall have sole discretion as to which of these remedies it shall provide. Dynatel Systems shall not reimburse or make any allowance to buyer for any labor or freight charges incurred.

3.02 **ON-SITE REPAIR:** On-site repair service is available for the APC Model 1301 only. Contact Dynatel Systems in Austin, Texas for specific charges.

4. NEW PRODUCT LIMITED WARRANTY

4.01 SELLER warrants its products to be free from defects in materials and workmanship, subject to the following terms and provisions:

- a) All test and measurement instruments, except APC Model 1301 and 1303, are warranted for twelve (12) months after date of shipment from SELLER to the original purchaser. APC Models 1301 and 1303 are warranted for ninety (90) days on labor and twelve (12) months on parts after date of shipment from SELLER to the original purchaser. All other SELLER'S products are warranted for ninety (90) days after date of shipment from SELLER to original purchaser.
- b) SELLER'S obligations under this warranty are limited to repairing, replacing or adjusting at SELLER'S option any of SELLER'S products which after normal and proper usage, proves to be defective on SELLER'S inspection, provided that the purchaser shall have reasonably inspected products when received and notified SELLER of any apparent defects within fifteen (15) days of receipt of shipment. SELLER shall not be liable for any injury or for any manufacturing costs of the buyer, or any other special or consequential damages sustained or expenses incurred by the buyer by reason of the use of any defective SELLER'S equipment.
- c) Equipment delivered by SELLER shall not be considered defective if it satisfactorily fulfills the order or complies with published specifications on standard catalog items. This warranty does not extend to any SELLER'S products which have been subjected to misuse, neglect, accident or improper applications, nor shall it extend to units which have been repaired or substantially altered outside the SELLER'S factory, nor to any associated instruments, equipment or apparatus.
- d) Products requiring repair may be returned to SELLER only after obtaining a Material Return Authorization (MRA) number. To obtain an MRA number, contact the SELLER'S Repair Department as referenced in paragraph 2.01. After receipt of the MRA number, equipment requiring repair or replacement should be shipped prepaid to the factory accompanied by a written statement setting forth the MRA number and defects observed. The MRA number should be clearly marked on the shipping carton and on the packing list.

5. IMPORTANT PURCHASER NOTICE

5.01 All statements, technical information and recommendations related to SELLER'S products are based on information believed to be reliable, but the accuracy or completeness thereof is not guaranteed. Before utilizing the equipment, the user should determine the suitability of the product for his intended use, and assumes all risks and liability whatsoever in connection with that use.

5.02 All statements or recommendations not contained in SELLER'S standard publications shall have no force or effect unless in an agreement signed by officers of SELLER, and the above is made in lieu of all warranties, express or implied.