OPERATING INSTRUCTION - ELECTRONIC

LEAD VERIFICATION SYSTEM

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1. GENERAL INFORMATION

1.1 Description

This section provides information pertaining to equipment, setup, operation and minor trouble-shooting of the Electronic Lead Verification System (ELVS). The ELVS is designed to provide wire identification, wire search, short and open circuit verification in cable fabrication. These test sets are to be used for continuity verification and circuit analysis in telephone central office bulk wiring operations.

1.2 System Description

The ELVS is comprised of four basic components:

1) Test Accessory Set, ITE-5420
2) Analyzer, ITE-5421
3) Master Test Encoder, ITE-5422
4) Encoder, 200 or 1000 Circuit ITE-5423 and ITE-5424, respectively.

1.21 Supplementary items that are useful in applications of ELVS:

1) ITE-4137A AC Continuity Test Set
2) R-3633 Cart or Telco Cart
3) KS-20406-L1 Cleaner, Spray
4) ITE-4431V 1/4 Amp "Slo Blo" Fuse
5) R-3359 Gray Plastic Tape

1.22 The following features are included in the ELVS:

(A) The System, through the use of test adapter cords, will identify individual leads by an alphanumeric display consisting of an "A" or "B" character and numerical digits.

(B) The System is capable of producing a simultaneous display of two or more conductors shorted to a common point through a resistance of up to 5 megohms using the HI-Z signal input mode.

(C) Individual leads may be identified when shorted to a common ground through a shunt impedance of 50 ohms of more when tested with the (LO-Z) low impedance mode.

NOTE: This feature is provided with the Master Test Encoder, ITE-5422 and 200 Circuit Encoder, ITE-5423, but is not provided with 1000 Circuit Encoder, ITE-5424.

(D) The System provides a visual and audible identification of a specific lead or group of wires.

(E) The System will identify leads carrying applied battery or ground, provided that the shunt resistance is 50 ohms or greater.

(F) Interface to circuits under test is provided by means of 50 contact KS-16672-L3 type connectors.

(G) Program Plugs (ITE-5421 Details 3 and 4) permit front or rear insertion of a test fixture to a terminal strip without reversing the display numbering format.

(H) Each of the 200 circuit capacity Encoders (ITE-5422 and 5423) are provided with two 50 contact output connectors multipled together. This allows several units to be wired together in tandem. In addition, each encoder is equipped with a five position zone switch:

Zone	Zone Range
1	000 - 199
2	200 - 399
3	400 - 599
4	600 - 799
5	800 - 999

allowing logic output for any 200 circuit numerical group from 000-199 group to 800-999 group. Each Encoder and Analyzer is compatible and interchangeable with all systems.

1.23 The ELVS requires at least two basic test units: (1) the ITE-5421 Analyzer and (2) an Encoder. Either the ITE-5422 Master Test Encoder (which contains 200 circuits) or the ITE-5423 200 Circuit Encoder, or the ITE-5424 1000 Circuit Encoder can be used. Only during a manual probing test operation can the ELVS operate with only an Analyzer and one Encoder.

1.24 The ITE-5423 200 Circuit Encoder (with LO-Z feature) can be used for most test operations. The ITE-5424 1000 Circuit Encoder (no LO-Z feature) is to be used when a large group of circuits are to be tested simultaneously.

1.25 The ITE-5422 Master Test Encoder is available for automatic scanning tests. However, it has 200 circuits available and can be used as a 200 circuit encoder. It can be connected to the ITE-5423 for a total of 400 circuits or the ITE-5424 for a total of 1,200 circuits to be probed manually.

1.3 Precautions Against Personal Injury, Equipment Damage and Service Interruptions

General precautions to be taken against personal injury, equipment damage and service interruptions are covered in Handbook 0 and are to be observed at all times as they apply to the operations being performed.

1.31 Do not probe the "Encoder Input" connectors on the Analyzer and the "Output" connectors on any Encoder with a metallic object such as a coin or probe tip. This action may cause a battery and ground short, thereby blowing battery fuses.

1.32 Avoid dropping any test equipment items.

1.33 To avoid excessive battery discharge, connect Analyzer to AC line when practical and push down power button when not in use.

1.4 References

G.I.C. 1.01 provides familiarization information pertaining to the operation of the ELVS.

1.41 Refer to the following sections of Handbook 9 for information pertaining to test applications of the ELVS for specific telephone systems:

Section	System
921	No. 1 Crossbar
922	No. 4 Crossbar
923	No. 5 Crossbar
924	Crossbar Tandem

2. EQUIPMENT DESCRIPTION

2.1 ITE-5420 ELVS Test Accessory Set

The ELVS Test Accessory Set provides test cords made available to interface with equipment peculiar to a specific telephone system. Test Cords ITE-9215 to 9225 are available to cover testing in all Crossbar Systems. List 1 of ITE-5420 includes cords required for No. 4A and Tandem Crossbar Systems. List 2 includes cords required for No. 1 and No. 5 Crossbar Systems.

2.11 The ITE-9214 Cables are available in the following lengths:

Code Number	Length
ITE-9214A	30 ft.
ITE-9214B	60 ft.
ITE-9214C	100 ft.

One of each of the above cables is supplied with all ITE-5420 Test Accessory Sets.

2.12 All equipment required as part of an ITE-5420 Test Accessory Set list will be supplied in an R-3790 Shipping Case.

2.2 ITE-5421 Analyzer (Figure 1)

The Analyzer provides the power supply for the System, an alphanumeric display, an audible test trouble alarm, and controls to regulate the signal level and analyze test trouble conditions. Interconnect cords (ITE-9214 and ITE-5421 Details 1 and 2) transmit information to the Analyzer from all Encoders. This encoded information is analyzed and displayed at the Analyzer.

2.21 Encoder Input Section is located at the left side of the Analyzer faceplate.

2.211 Two 50 contact INPUT connectors are provided. "M" is direct and "MP" is programmable.

2.212 Program Connector "P" and Programming Plugs Detail 3 and 4 provide a means of arranging the UNITS and TENS input circuits in a required manner.

2.22 Display Control Section is located at the center of the Analyzer faceplate.

2.221 Display Area

The Readout Display consists of three cold cathod (Nixie) tubes to display the Hundreds, Tens and Units digits, and four neon tubes display Encoder group information (A & B) with the "short indicator bars".

2.22 The MODE Switch is a two position switch providing either the RANDOM or SELECT modes:

1) In the RANDOM mode any input line probed will display a number.

2) In the SELECT mode only the number(s) set on the selector switches will display. All other lines contacted will cause the short indicator bars to display. (HI SENSITIVITY switch position only.)

2.223 The Decade Selector Switches interrogate, for display, lead numbers that are involved in a short or select leads for a search operation. With the MODE switch in SELECT position, only the specific number or decade group of numbers ("N" indicating neutral) will produce a display when probed. The neutral position "N" provides the RANDOM mode of operation for that decade only.

2.224 The GROUP selectors (A & B) are two position lever switches; one for each Encoder group. With a GROUP selector in the OFF position no input in that group will display a number (the short indicator will display).

2.23 Alarm Section is located at the right of the Analyzer faceplate.

2.231 TEST MODE Selector provides the following:

1) OFF - No alarm (all test functions disabled).

2) SEARCH - Alarm sounds on any displayed number in RANDOM mode or on number selected by decade switches in SELECT mode.

3) SHORTS - Alarm sounds only on occurrence of a multiple number in any decade.

4) VERIFY - Alarm sounds when automatic scan testing between multiple circuits identified by A and B if an open, short, or reversal is present. Two terminations of a lead under test identified by a single number but with different group prefixes will not cause an alarm.

5) COORD (Coordinate)

a) COLUMNS - Alarms sounds only on occurrence of a multiple image in UNITS display.

b) ROWS - Alarm sounds only on occurrence of a multiple image in the TENS display.

2.232 Alarm LATCH Switch, a three position lever; provides:

1) Up position: Alarm LATCH OFF.
2) Center position: Alarm LATCH ON.
3) Down (momentary) position: LATCH RESET.

In the ON position the occurrence of an alarm condition (trouble) will set the alarm latch flip-flop. The alarm latch produces a 7.8 Hz modulation on the 500 Hz alarm tone. The alarm latch can be reset manually by depressing the LATCH switch or turning it OFF. The presence of an alarm condition produces a continuous tone over-riding the alarm latch modulation.

2.233 Operating the MUTE pushbutton sets a mute flip-flop silencing an audible tone. The mute flip-flop automatically resets when the condition producing the alarm is removed. If the LATCH is ON, the removal of the alarm condition produces the modulated tone indicating the trouble has been cleared.

NOTE: The MUTE pushbutton is to silence steady tone and the RESET switch is to silence modulated tone and clear system alarm memory.

2.234 The VOLUME control allows the level of the 500 Hz alarm tone to be varied (LO-HI) to suit the operator. This control does not allow the volume level to be reduced to zero.

2.24 Signal Control Section (Area D of Figure 1) is located at the lower center area of the Analyzer faceplate.

2.241 The SENSITIVITY switch should be left in the "HI" position for normal operation. The "LO" sensitivity position should only be used in situations where long cabling is being tested or in high noise environments. The HI SENSITIVITY switch position must be used for analyzing shorts or when using the SELECT mode.

2.242 The SIGNAL LEVEL potentiometer varies the HI-Z probe voltage between zero and 12 volts. 47K ohm isolation resistors apply this signal to:

1) The red HI-Z banana jack.

2) The PROBE BNC connector (HI-Z toggle switch position).

3) The faceplate panel.

4) Earth ground (with switch in the GROUND position and the power cord plugged in).

2.243 The IMPEDANCE LEVEL potentiometer sets the threshold resistance of the low impedance (LO-Z) measuring circuitry.

2.244 The EXT/LOCAL switch connects the IMPEDANCE LEVEL control to a remote readout in the EXTERNAL position and disables the LOCAL controls.

2.25 Power

2.251 The BATT TEST switch and indicator are located at the upper left area of the Analyzer faceplace. Two separate battery supplies are provided. With the instrument on, the charge state of either battery may be read on the indicator by depressing the BATT TEST switch to position

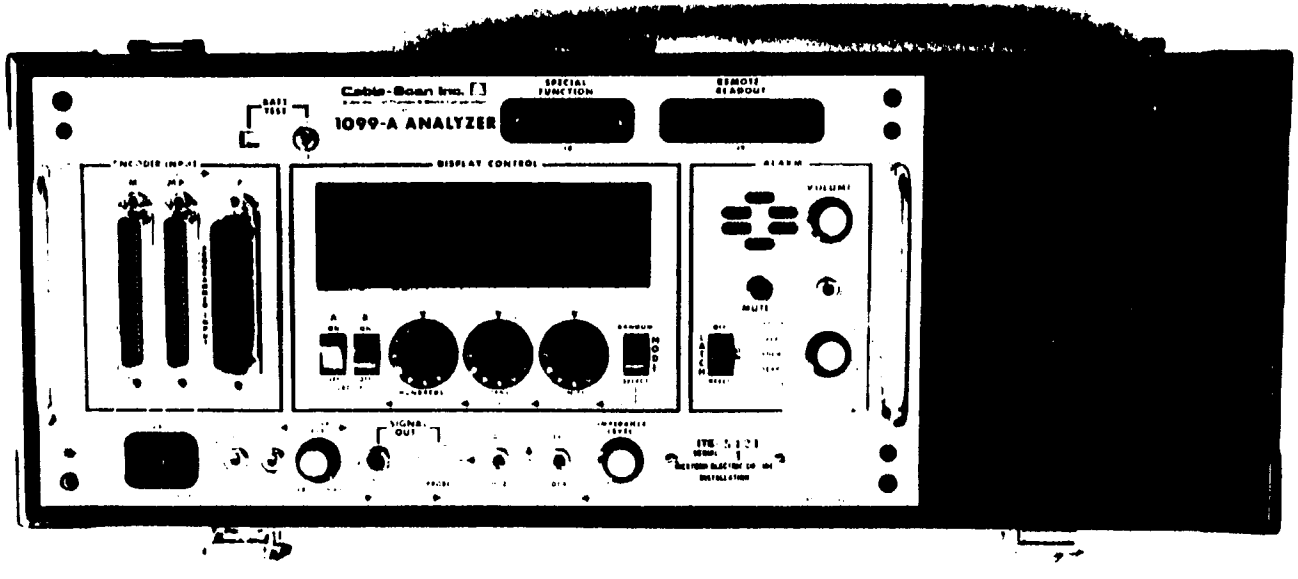


FIG. 1 ITE-5421 ANALYZER

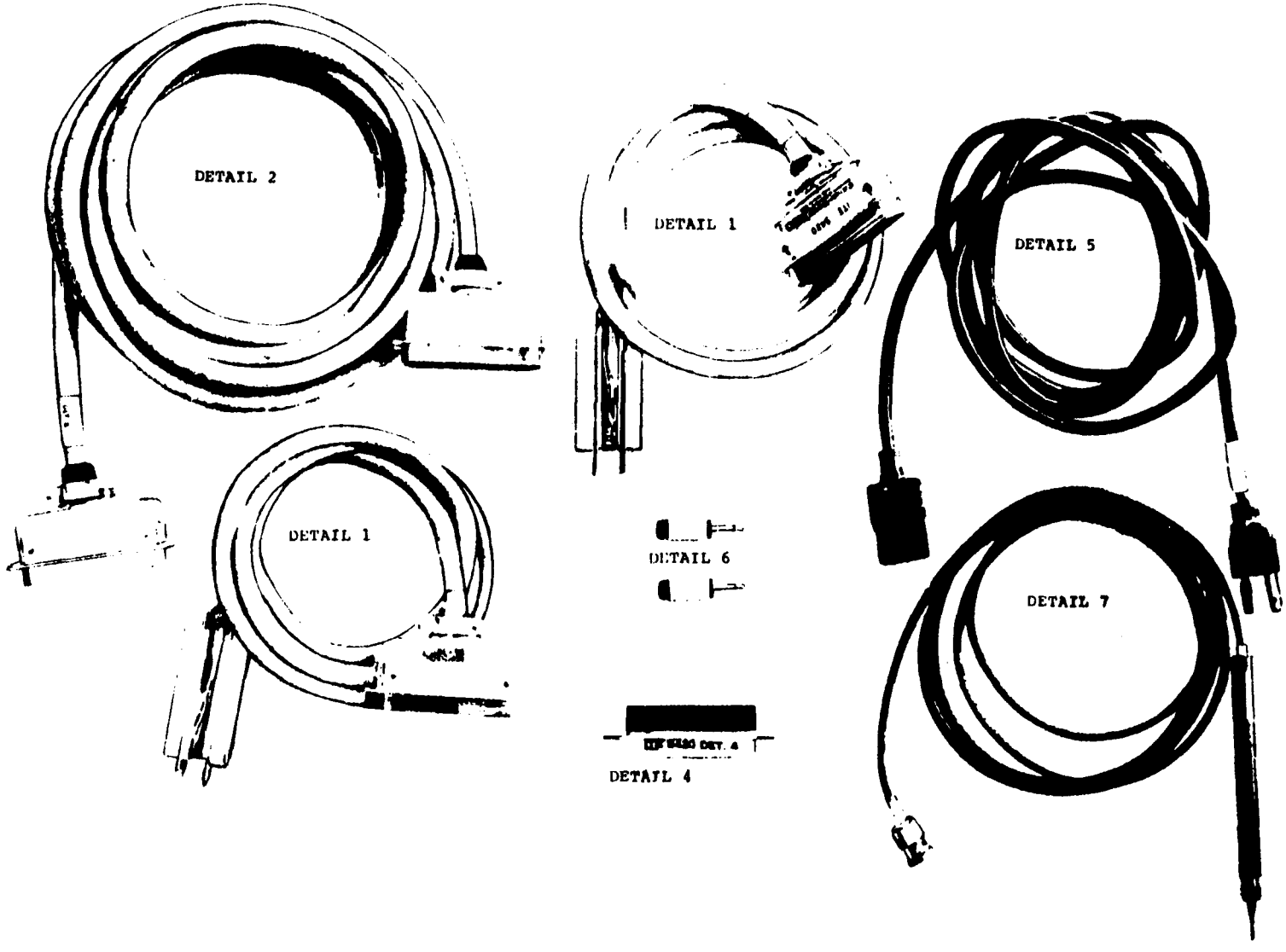


FIG. 2 ITE-5421 DETAILS

1 or position 2. If the indicator reads in the red, the batteries should be recharged.

NOTE: THE BATTERY LIFE WILL BE SHORTENED IF DEEPLY DISCHARGED (BATTERY OPERATION IN EXCESS OF 8 HOURS) REPEATEDLY.

2.252 The CHARGER Connector is located at the lower left corner of the faceplate. The internal batteries are charged whenever the ITE-5421 Detail 5 Power Cord is plugged into 115 Volts AC. The off-on switch may be in any position for charging, and over-charging is not possible. The System will operate from eight hours to several months on the batteries without charging depending on how often the display is used.

2.253 The PULL ON switch is located at the lower right corner of the faceplate. This pull-on, push-off switch connects the batteries to the system. This switch is automatically turned off upon closing the instrument cover.

NOTE: Verify that the switch is pushed down in the "off" position when instrument is not in use with the cover removed. The switch in the "on" position causes battery drain.

2.26 ITE-5421 Details 1-7 (Figure 2) are located in the compartment on the right side of the ITE-5421 Carrying Case.

2.3 ITE-5424 1000 Circuit Encoder (Figure 3)

The 1000 Circuit Encoder is capable of translating 1000 inputs of test information to be analyzed and displayed by the ITE-5421 Analyzer.

2.31 Input Section utilizes most of the left side of the 1000 Circuit Encoder faceplate.

2.311 This Encoder uses five input zones. Each ZONE contains four input connectors. Each input connector contains 50 input circuits for a total of 200 inputs per ZONE, for a total of 1000 input circuits per ITE-5424 1000 Circuit Encoder (200 inputs per zone x 5 zones = 1000 input circuits). Refer to Figure 4 for a further view.

2.32 Output Section is located at the right side of the faceplate.

2.321 The Output section consists of two 50 contact connectors arranged in parallel. Either connector serves as an output to the Input Connector (M or MP) of the ITE-5421 Analyzer via interconnect cords (ITE-9214 or ITE-5421 Details 1 and 2). The other output allows an additional Encoder to be attached.

2.33 Signal Control Section is located at the lower area of the faceplate.

2.331 The GROUP toggle switch selects the desired group identity that applies to all 1000 input lines. For example setting GROUP switch in the "B" position will cause the Analyzer to display numbers B000 through B999 when a signal is applied to the Encoder input lines.

2.332 The HI-Z test signal from the ITE-5421 Analyzer SIGNAL LEVEL Control (Par. 2.242) is available from:

1) The red HI-Z banana jack.

2) The BNC PROBE jack in the HI-Z switch position.

3) The faceplate panel.

2.333 The LO-Z test signal from the ITE-5421 Analyzer IMPEDANCE LEVEL Control (Par. 2.243) is available from the BNC PROBE jack in the LO-Z switch position.

NOTE: The ITE-5424 1000 Circuit Encoder does not provide the LO-Z feature in any of the 1000 input circuits, and should not be used on circuitry where resistance shorts may be encountered.

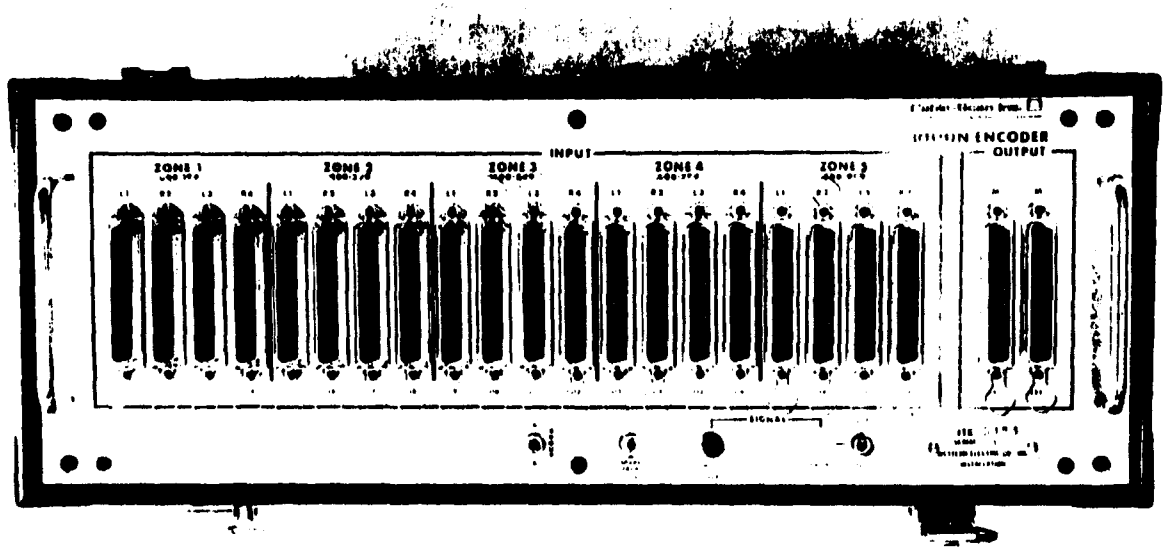


FIG. 3 ITE-5424 1000 CIRCUIT ENCODER

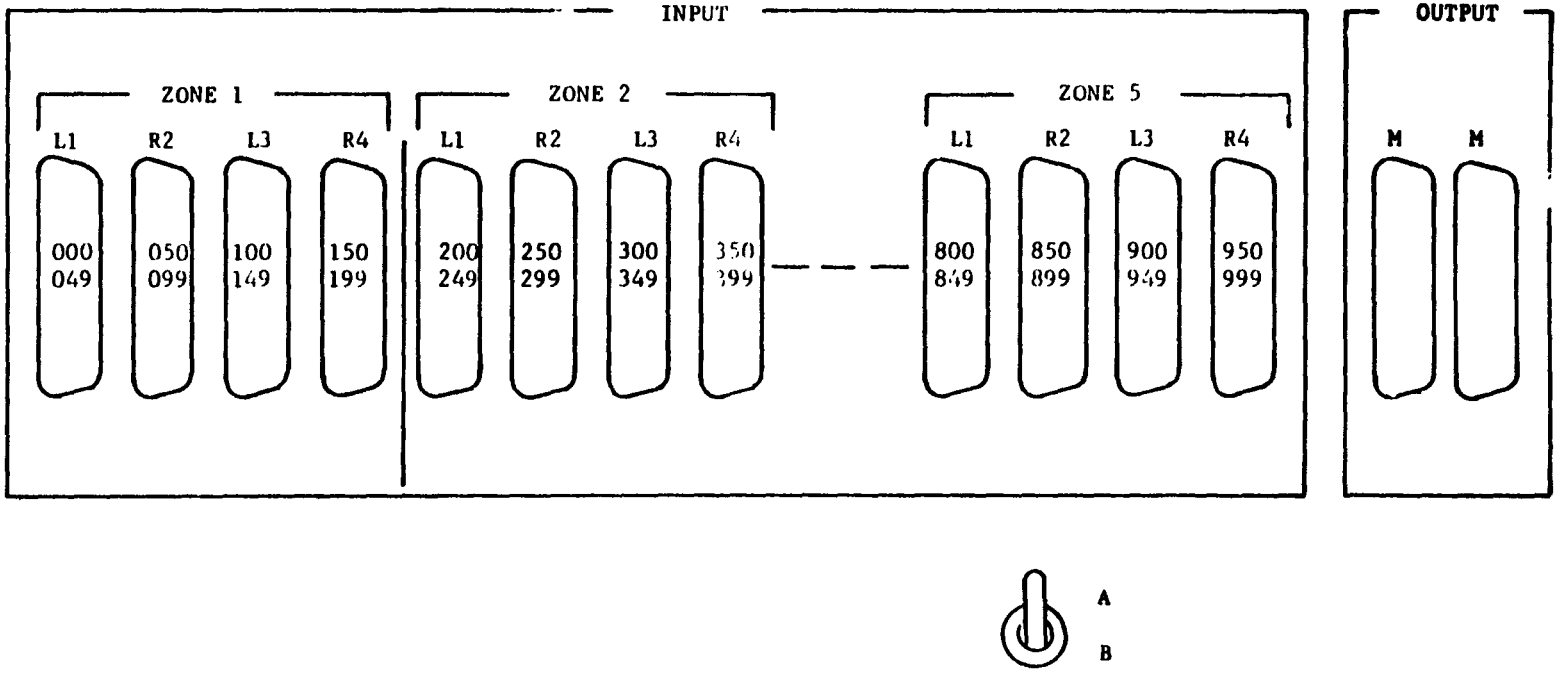


FIG. 4 ZONE NUMBERING SEQUENCE

2.334 The SPARE Jack provides an isolated pair available throughout an interconnected system on any encoder. This jack can be utilized to provide voice communications when necessary. Two Utility Plugs (ITE-5421 Detail 6) provide a wire pair input to the system facilitating a talk path for an ITE-4137A AC Continuity Test Set.

2.4 ITE-5423 200 Circuit Encoder (Figure 5)

The 200 Circuit Encoder is capable of translating 200 inputs of test information to be analyzed and displayed by the ITE-5421 Analyzer.

2.41 Input Section is located at the left side of the faceplate.

2.411 The input numbering sequence for the 200 Circuit Encoder is arranged in zones of 200 inputs, each zone containing four connectors of 50 input circuits each. This numbering sequence is identical for all Encoders.

2.412 This Encoder contains only one zone available for the input of 200 circuits. However, the zone range or band spread of 200 display numbers is selected by the operator with the ZONE switch. For a further view refer to Figure 6.

2.413 The hundreds number of each input connector is dependent on the zone selected. Connectors L1 and R2 will display even hundreds numbers, whereas Connectors L3 and R4 will display odd hundreds numbers. An exception is when a split group (A/B) is selected on the GROUP switch. Connectors L1 and R2 will display A000-099 and Connectors L3 and R4 will display B000-099. This will occur regardless of the zone selected. A further explanation of this concept is given in Paragraph 2.432.

2.42 Output Section is located at the center of the faceplate.

2.421 This Output section is identical to that of the ITE-5422 Master Test Encoder and the ITE-5424 1000 Circuit Encoder which is described in Paragraph 2.32.

2.43 Format Section is located at the right side of the faceplate.

2.431 The ZONE switch selects the ZONE RANGE identity for the Encoder's output data.

ZONE	ZONE RANGE
1	000-199
2	200-399
3	400-599
4	600-799
5	800-999

2.432 The GROUP switch A and B positions select the desired group identity that applies to all 200 input lines. For example, setting the ZONE switch to 2 and the GROUP switch to A will cause the Analyzer to display numbers A200 through A399 when signal is applied to the Encoder input lines. For the GROUP switch position labeled A/B, the input lines have the following identity:

Input Connector	Display
L1	A000-A049
R2	A050-A099
L3	B000-B049
R4	B050-B099

In the A/B position the ZONE switch has no function. The A/B position or split group will utilize one Encoder of 200 circuit capacity to test 100 leads or less with the origin and destination terminations at close proximity.

2.44 Signal Control Section is located at the lower area of the faceplate.

2.441 The SIGNAL OUTPUT jacks and switch are identical to those of the ITE-5422 Master Test Encoder and the ITE-5424 1000 Circuit Encoder and described in Paragraphs 2.332 and 2.333.

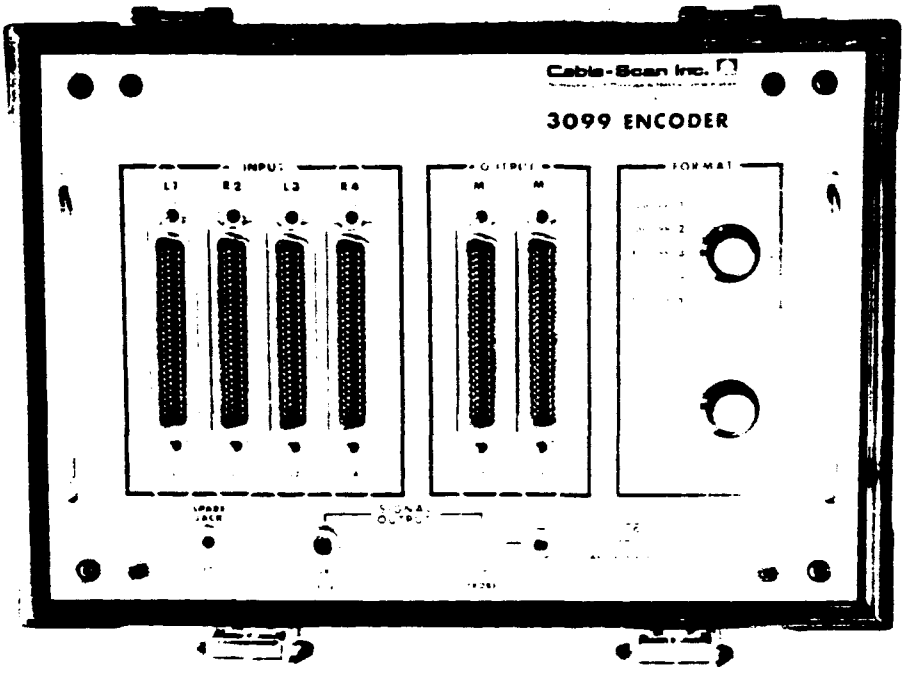


FIG. 5 ITE-5423 200 CIRCUIT ENCODER

ZONE SW SETTING	GROUP SW SETTING
1	A OR B
2	A OR B
3	A OR B
4	A OR B
5	A OR B
ANY	A/B

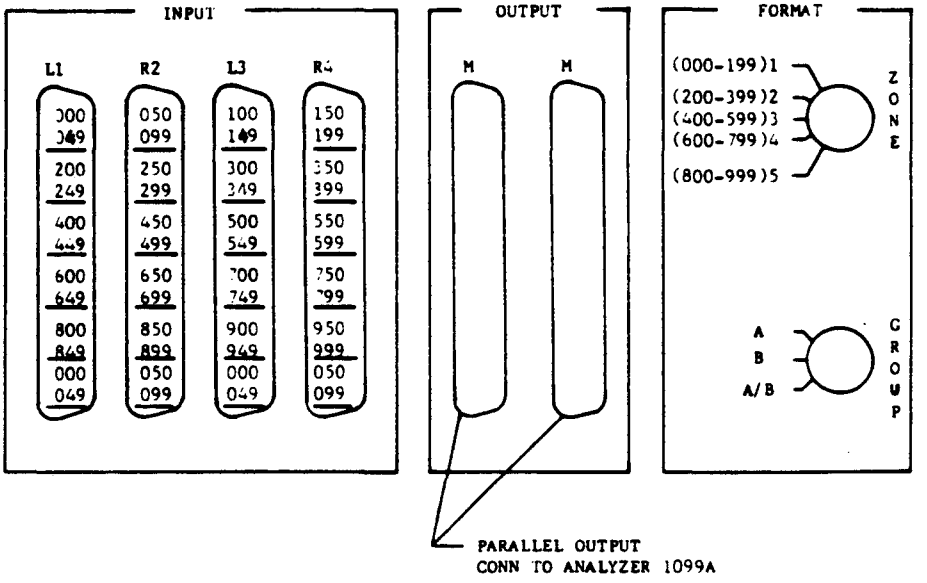


FIG. 6 INPUT NUMBERING SEQUENCE

2.442 The SPARE Jack is identical to that of the ITE-5422 Master Test Encoder and the ITE-5424 1000 Circuit Encoder described in Paragraph 2.334.

2.5 ITE-5422 Master Test Encoder (Figure 7)

The Master Test Encoder translates 200 inputs of test information with the capability of automatically applying a test signal to all 200 inputs in sequence.

2.51 Input Section is located at the left side of the faceplate.

2.511 This Input section is identical to that of the ITE-5423 200 Circuit Encoder described in Paragraph 2.41.

2.52 Output Section is located at the center left of the faceplate.

2.521 This Output section is identical to that of the ITE-5423 200 Circuit Encoder and the ITE-5424 1000 Circuit Encoder which is described in Paragraph 2.32.

2.53 Format Section is located on the center right of faceplate.

2.531 This Format section is identical to that of the ITE-5423 200 Circuit Encoder described in Paragraph 2.43.

2.54 Scan Control Section is located on the right of faceplate and is peculiar to the ITE-5422 Master Test Encoder only.

2.541 The Scan Controller operates in three scan modes: END POINT 1, END POINT 2, and SET POINT.

2.5411 END POINT 1 Scan Mode

With the selector switch in the END POINT 1 mode the Scan Controller Circuitry will apply a test signal to each input line in a numerical sequence, upon the receipt of a "Scan" command by the SCAN toggle switch. This signal will start at input 000 and terminate at the three digit number selected by the SCAN LIMIT thumbwheel switches, provided that no alarm condition signal is received from the Analyzer during the scan sequence. At the end of the automatic scan operation, the Analyzer display will be extinquished and the green PASS lamp on the Master Test Encoder will be on. Conversely, if an alarm condition is detected by the Analyzer at any point prior to reaching the Scan Limit, the red FAIL lamp will turn on and a continuous signal will be applied to the input lead that is causing the alarm condition.

2.5412 END POINT 2 Scan Mode

This mode is basically identical to the END POINT 1 mode except that the controller will scan a second group of leads provided the ZONE LIMIT thumbwheel is set to 1 or the higher hundreds number of the Range in the Zone selected. Refer to Figure 8.

2.5413 SET POINT Scan Mode

In this mode, the Scan Controller, upon a "Scan" command, will advance to the number set on the SCAN LIMIT thumbwheel switch. A continuous signal is applied to that point until a "Step" command is given by the STEP toggle switch. Each operation of the STEP switch will advance the test signal to the next number in sequence.

2.542 PRESET Switch positions are a summary of Paragraph 2.541:

1) OFF - No test signal is applied.

2) END POINT 1 - The Scan Controller automatically applies a test signal, sequentially starting at 000 and ending on the number selected on the SCAN LIMIT thumbwheel.

3) END POINT 2 - This mode causes a zone to be split into two scanning orders of one hundred leads each. Each group is scanned separately with the limit or highest number scanned in each group determined by the number selected on the SCAN LIMIT thumbwheel. Refer to Figure 8.

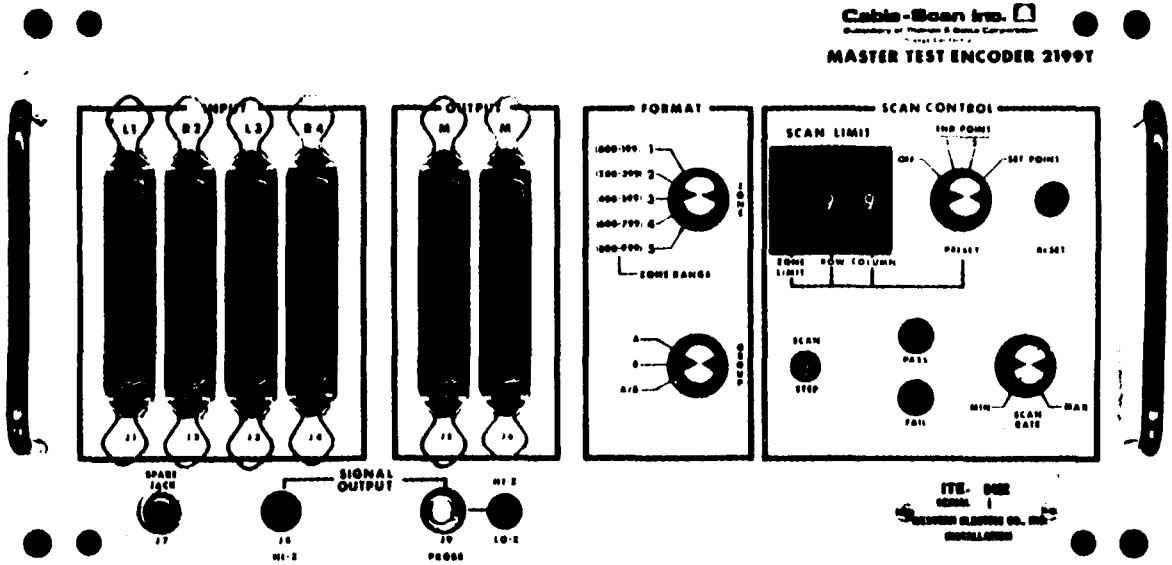


FIG. 7 ITE-5422 MASTER TEST ENCODER

4) SET POINT - The Scan Controller upon activation of the Scan switch advances to, and continuously applies a test signal to the number set on the SCAN LIMIT thumbwheel switch. Each operation of the STEP switch will advance the signal to the next higher number.

2.543 SCAN LIMIT Thumbwheel Switch allows the last number in a test sequence to be selected by the operator. For example, setting 059 on the thumbwheel will allow the Scan Controller to sequentially test line 000 through 059 in either END POINT 1 or END POINT 2 preset mode.

2.5431 Setting 159 on the thumbwheel switch will allow lines 000 through 159 to be tested in END POINT 1 mode and lines 000 through 059 and 100 through 159 to be tested in END POINT 2 mode. (Note that lines 060 through 099 are skipped.)

2.5432 The scan limits for END POINT 2 mode are shown in Figure 8 in its coordinate form. (Note that units correspond to COLUMNS and that tens and hundreds correspond to ROWS.)

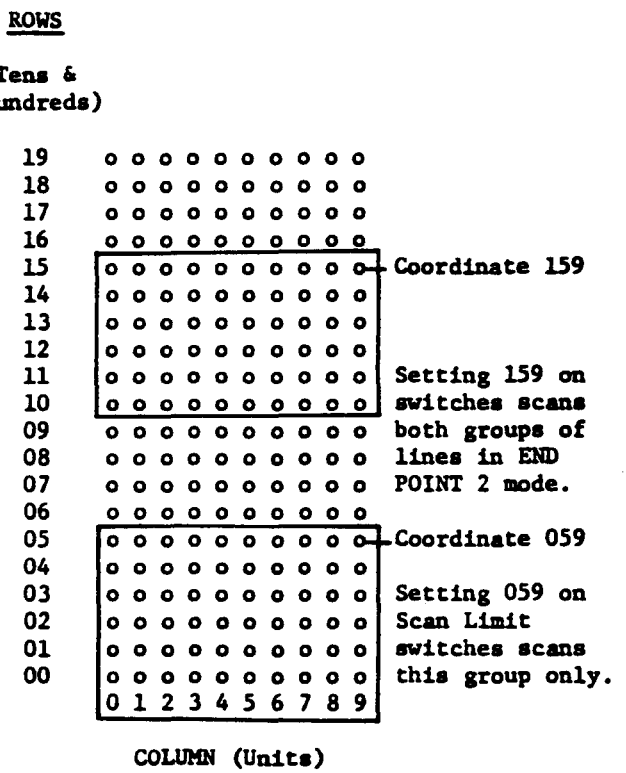


FIGURE 8 TYPICAL END POINT 2 MODE OPERATION

2.5433 The numbers referred to in Figure 8 correspond to Zone 1 only. When other higher numbered zones are selected on the ZONE selector switch, add 200 for each zone.

Example:

ZONE		ZONE LIMIT		Display Image
1	+	0	=	000 - 099
1	+	1	=	100 - 199
2	+	0	=	200 - 299
2	+	1	=	300 - 399
3	+	0	=	400 - 499
3	+	1	=	500 - 599
4	+	0	=	600 - 699
4	+	1	=	700 - 799
5	+	0	=	800 - 899
5	+	1	=	900 - 999

2.544 SCAN/STEP Switch is a two directional momentary toggle switch. Operating it to the up position initiates an Automatic Scan in an END POINT mode or sets the start-point in the SET POINT mode. Operating it to the down position advances the test signal from the number displayed to the next number in sequence in either mode of operation. If the Scan Controller is in the reset condition (Paragraph 2.547) operating the STEP switch will cause the test signal to return to lead 000.

2.5441 If an alarm condition is present the STEP switch must be used to advance the Scan Controller.

2.545 The PASS/FAIL lamps function only in the END POINT modes.

2.5451 The PASS lamp (green) indicates that the scan controller sequentially applied a test signal to all lines from 000 through the SCAN LIMIT end point without receiving an alarm signal from the Analyzer, or that any troubles were manually stepped over, and the scanning continued.

2.5452 The FAIL lamp (red) indicates that an alarm signal is being received during the automatic scan operation.

2.546 The SCAN RATE control varies the scan rate linearly between 10 circuits per second (MIN) and 30 circuits per second (MAX). At the slowest rate, approximately 20 seconds is required to test 200 leads. At the fastest rate, approximately 6.7 seconds are required to test 200 leads. The slow rate is provided to allow testing on very long leads.

2.547 The RESET pushbutton re-establishes the "ready-to-scan" standby condition. In the reset condition the scan controller is ready to apply signals starting on line 000; but the display will remain dark until the SCAN or STEP commands are given by the operator. At the completion of a scan operation, the scan controller automatically returns to the reset condition.

2.55 Signal Control Section is located at the lower area of the faceplate.

2.551 The SIGNAL OUTPUT jacks and switch are identical to those of the ITE-5423 200 Circuit Encoder and the ITE-5424 1000 Circuit Encoder described in Paragraph 2.332.

2.552 The SPARE jack is identical to that of the ITE-5423 200 Circuit Encoder and the ITE-5424 1000 Circuit Encoder described in Paragraph 2.334.

3. ENCODER PRINCIPLES AND INPUT FORMAT

3.1 The Encoder (ITE-5422, 5423, or 5424) receives test information from the equipment under test via test adapter cords (ITE-9215 to 9225) and translates it to data that is meaningful to the System. This data is transmitted to the ITE-5421 Analyzer via an interconnect cable (ITE-9214 and ITE-5421 Details 1 and 2) where it is analyzed and displayed.

3.2 The numbering format for the input connectors on all Encoders is illustrated in Figure 9. All wire assignments to the contacts illustrated in this figure would appear in the readout window as a three digit display. The hundreds or most significant digit will appear even in connectors L1 and R2 and odd in connectors L3 and R4. The display numbers are prefixed by an "A" or "B" display indicating group identity.

3.3 The input numbering sequence for all Encoders is arranged in zones of 200 input circuits each. A zone contains 4 connectors, each with a capacity of 50 circuits (4 connectors x 50 inputs each = 200 inputs).

3.31 All Encoders are capable of displaying the numbers in the following 5 zones:

Zone	Zone Range
1	000 - 199
2	200 - 399
3	400 - 599
4	600 - 799
5	800 - 999

3.32 Each of the four connectors in any zone are labeled with a code that is helpful when attaching the test adapter cords. The connectors are labeled, from left to right, L1, R2, L3, and R4 as shown in Figure 9.

3.321 Input connector numbering capabilities are presented in Table A.

TABLE A

Zone	Input Connector			
	L1	R2	L3	R4
1	000 - 049	050 - 099	100 - 149	150 - 199
2	200 - 249	250 - 299	300 - 349	350 - 399
3	400 - 449	450 - 499	500 - 549	550 - 599
4	600 - 649	650 - 699	700 - 749	750 - 799
5	800 - 849	850 - 899	900 - 949	950 - 999

3.4 All Encoders have an "Output Section" consisting of two connectors connected together in parallel. Either connector may serve as an output to the "Encoder Input" connector (M or MP) of the ITE-5421 Analyzer. The second connector allows an additional Encoder to be attached. Several Encoders (any type) may be tandem connected in this manner. The ELVS can attain a total of 2000 inputs in a test setup (A000 - 999 and B000 - 999) with a tandem Encoder configuration.

3.5 The ITE-5424 1000 Circuit Encoder has a capacity of 1000 inputs (A or B, 000 - 999). Both the ITE-5422 Master Test Encoder and the ITE-5423 200 Circuit Encoder have a capacity of 200 inputs each. However, these Encoders are capable of attaining a readout display of 1000 inputs (A or B, 000 - 999). This is achieved through the use of ZONE and GROUP switches that are described in Par. 2.43 which treats the Format Section of the ITE-5423 200 Circuit Encoder.

3.6 The ITE-5422 Master Test Encoder and the ITE-5423 200 Circuit Encoder have the LO-Z feature for resistance probing on all 200 inputs of each Encoder. The ITE-5424 1000 Circuit Encoder does not have this feature in its 1000 input circuits and is to be used on dry or clear circuits only. However, the LO-Z test signal is available from the ITE-5421 Analyzer IMPEDANCE LEVEL Control at the BNC PROBE jack with the SIGNAL LEVEL switch in the LO-Z position.

4. TEST SETUP INFORMATION

4.1 Preparations

4.11 Verify that all test equipment necessary to perform the prescribed continuity verification tests is available. Information regarding this equipment and test methods are provided in the Section pertaining to the use of the ELVS in a specific telephone system. A list of Handbook 9 continuity verification Sections is provided in Paragraph 1.41 of this Section.

4.12 Examine all equipment for any obvious damage.

4.121 If a defective condition exists, refer to Paragraph 6 of this Section to determine if on-site repairs can be made.

4.122 If any unit of equipment is unable to be repaired on the job site, the Regional Installation Stockkeeping Tool Coordinator should be contacted to determine the disposition of the equipment.

4.13 All equipment not essential to the test operation, such as equipment carrying cases and ITE-9214 Interconnect Cords should be removed from the work area and stored in the assigned storage area.

4.14 The test equipment may be arranged on a portable cart for convenience. The ED-90603-70 Group 1 cart may be available from the telephone company or the R-3633, Cart, Material Handling, Multi-Tier, can be ordered from Regional Installation Stockkeeping.

4.2 Test Set Operational Tests

This series of tests are provided to insure that the equipment is functioning properly and reporting correct test information to the operator.

NOTE: Paragraph 6 of this section may be referred to for instructions covering possible trouble conditions encountered.

4.21 Analyzer and Encoder Function Tests will verify that the Analyzer and Encoders are in proper working order and function together as a system. The tests should be performed to cover all Encoders (ITE-5422, 5423, and 5424) associated with the ITE-5421 Analyzer.

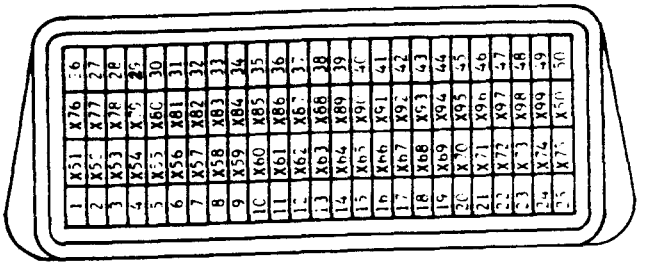
4.211 ITE-5421 Analyzer Tests will verify the proper operation of the main functions of the Analyzer.

NOTE: All controls not mentioned in these procedures are to be disregarded.

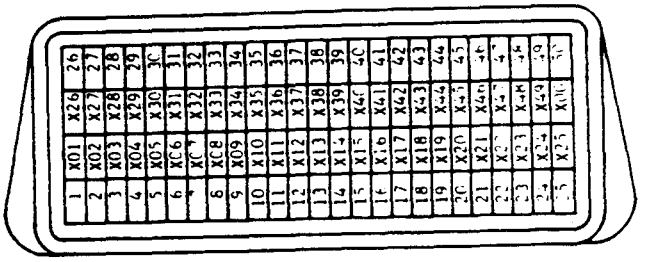
Step 1: With the power cord disconnected pull power switch (PULL ON) to the on position. Operate BATT TEST toggle switch to the "1" position and observe that the needle of the BATT TEST indicator has deflected from the red area to the white. Repeat for second battery, operating the toggle switch to the "2" position. This

	ZONE 1				ZONE 2	
	L1	R2	L3	R4	L1	R2
1	001	051	101	151	201	251
2	002	052	102	152	202	252
3	003	053	103	153	203	253
4	004	054	104	154	204	254
5	005	055	105	155	205	255
6	006	056	106	156	206	256
7	007	057	107	157	207	257
8	008	058	108	158	208	258
9	009	059	109	159	209	259
10	010	060	110	160	210	260
11	011	061	111	161	211	261
12	012	062	112	162	212	262
13	013	063	113	163	213	263
14	014	064	114	164	214	264
15	015	065	115	165	215	265
16	016	066	116	166	216	266
17	017	067	117	167	217	267
18	018	068	118	168	218	268
19	019	069	119	169	219	269
20	020	070	120	170	220	270
21	021	071	121	171	221	271
22	022	072	122	172	222	272
23	023	073	123	173	223	273
24	024	074	124	174	224	274
25	025	075	125	175	225	275
26	026	076	126	176	226	276
27	027	077	127	177	227	277
28	028	078	128	178	228	278
29	029	079	129	179	229	279
30	030	080	130	180	230	280
31	031	081	131	181	231	281
32	032	082	132	182	232	282
33	033	083	133	183	233	283
34	034	084	134	184	234	284
35	035	085	135	185	235	285
36	036	086	136	186	236	286
37	037	087	137	187	237	287
38	038	088	138	188	238	288
39	039	089	139	189	239	289
40	040	090	140	190	240	290
41	041	091	141	191	241	291
42	042	092	142	192	242	292
43	043	093	143	193	243	293
44	044	094	144	194	244	294
45	045	095	145	195	245	295
46	046	096	146	196	246	296
47	047	097	147	197	247	297
48	048	098	148	198	248	298
49	049	099	149	199	249	299
50	000	050	100	150	200	250

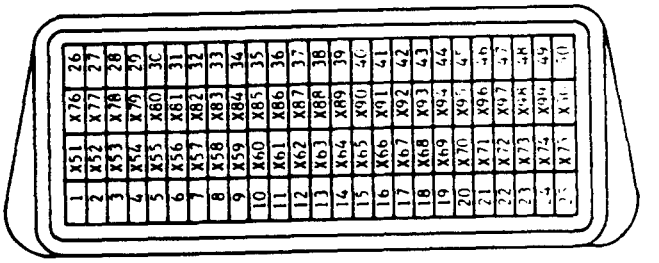
RP-C627



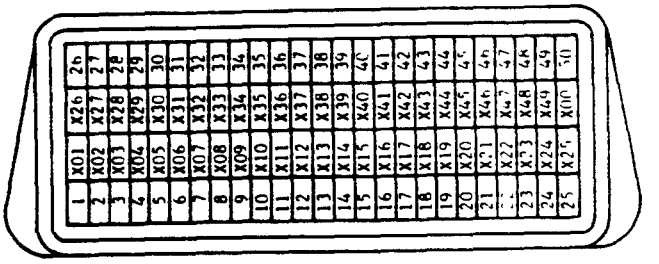
R4



L3



R2



L1

FIG. 9 ZONE NUMBERING FORMAT

test will insure that the Analyzer has good battery potential and that no battery fuses have been blown. Refer to Paragraph 6.2 for information if fuse replacement is necessary.

NOTE: To avoid excessive battery discharge during normal testing operations, connect Analyzer to AC line with ITE-5421 Detail 5 Power Cord.

Step 2: Verify that the "P" Connector of the Encoder Input section contains an ITE-5421 Detail 3 Standard Program Plug and that it has been properly inserted and secured by the top and bottom mounting screws.

Step 3: Attach an interconnect cord (ITE-5421 Detail 1 or 2) to the "MP" Connector of the Encoder Input Section of the Analyzer. Connect the opposite end of the interconnect cord to one of the M Connectors of the Output Section of an Encoder. (Any Encoder, ITE-5422, 5423, or 5424, can be used to test the Analyzer at this time).

Step 4: a) At the Analyzer, set the SIGNAL LEVEL Potentiometer, located in the Signal Level Control Section, to the MAX position. Depress the A and B switches, located in the Display Control Section, to the OFF position and the MODE switch in the same section to the SELECT position.

b) At the Encoder, connect a test probe to the HI-Z or the BNC jack of the Signal Output Section. Set the SIGNAL OUTPUT toggle switch to the "HI-Z" position if the BNC jack is to be used.

c) Randomly probe the Input connector contacts of the Encoder and observe that the two horizontal "short indicator bars" located at the left of the display window of the Analyzer, light upon probe contact. This operation will insure that the Analyzer is capable of displaying a short circuit test trouble condition.

NOTE: DO NOT PROBE OR TOUCH WITH A METALLIC OBJECT EITHER THE "M" OR "MP" CONNECTORS OF THE ENCODER INPUT SECTION OF THE ANALYZER OR THE "M" CONNECTORS OF THE OUTPUT SECTION OF AN ENCODER CONNECTED TO THE ANALYZER.

Step 5: a) At the Analyzer Display Control Section, set the GROUP A and B switches to the ON positions and the MODE switch to SELECT. Turn all three decade selector switches (HUNDREDS, TENS and UNITS) to the "N" (neutral) positions.

b) Probe the contacts of the Input connectors of the Encoder and observe that the Nixie tube readouts in the Analyzer display various numbers as the contacts are probed. Particularly observe the Units and Tens digits (the Hundreds digits will be verified in a further step).

Step 6: a) At the Analyzer Alarm Section, set the VOLUME potentiometer at approximately midway between "LO" and "HI" and set the TEST MODE selector switch to the SEARCH position.

b) Probe the contacts of the Input connectors of the Encoder and note that at the time contact is made a steady tone is heard along with a visual display of the input number [illegible].

Step 7: a) Set the LATCH lever switch in the Alarm Section of the Analyzer to the ON position and advance the TEST MODE selector switch to the SHORTS position.

b) Carefully probe one contact of an Input connector and observe that there is a display and that no tone is heard at the Analyzer.

c) Short two or more contacts together and observe that there is a multiple display and a steady tone is heard.

d) Depress the MUTE push-button and note that the tone is silenced and the multiple display remains.

e) Remove the short condition and verify that a modulated tone can be heard and that there is no display.

f) Depress the LATCH switch to the RESET position and verify that the modulated tone silenced and no display is observed.

Step 8: a) Repeat Steps 7a thru 7d and hold the short condition in steady. The display should consist of an alphabetic character (A or B) preceding the multiple image. (Example, A 02Ø). The character A pertains to the group selected for the Encoder reporting the short to the Analyzer.

b) Working from left to right, rotate the first Decade Selector Switch, that pertains to a read-out that contains a multiple image, until a single number appears in all "Nixie" tube read-outs.

Example 1 - If contacts 09 and 10 were shorted together the display image would appear as superimposed 009 and 010. The operator would set the TENS Decade Selector to "1" this would present an image of "010".

Example 2 - If contacts 08, 09 and 10 are shorted together, the image after "0" is selected on the TENS Decade Selector will be superimposed 008 and 009. The operator would advance the UNITS Decade Selector to "8" and "9", presenting a display image of "008" and "009", respectively. The selection of "1" on the TENS Decade Selector will present an image of "010" and all other selections will affect a dark image with the exception of the short bars.

NOTE: The selection of a number by any Decade Selector, provided that the others are in the "N" position, gates for display the number selected along with any and all other numbers of other decades involved in the common short.

4.212 ITE-5424 1000 Circuit Encoder Tests will verify the credibility of the ITE-5424 1000 Circuit Encoder numbering format.

Step 1: a) Attach an interconnect cord (ITE-5421, Detail 1 or 2) to the "MP" Connector in Encoder Input Section of the Analyzer. Connect the opposite end of the interconnect cord to one of the "M" Connectors of the Output Section of the Encoder.

b) At the Analyzer, verify that: in the Display Control Section, the A and B Group switches are in the ON position, the three Decade Selector switches (HUNDREDS, TENS, and UNITS) are set to the "N" position; in the Alarm Section the TEST MODE selector switch is in the OFF position (this is necessary only to prevent the alarm tone from annoying the operator); and in the Signal Control Section SIGNAL LEVEL potentiometer is set to the MAX position.

Step 2: a) At the Encoder, connect or verify as connected, a test probe to the HI-Z or the BNC jack (if the BNC jack is used be sure that the SIGNAL OUTPUT toggle switch is in the HI-Z position.)

b) Run the probe along the contacts of each connector in all five zones and verify the display with Table B.

Step 3: While applying the probe to an input connector contact, operate the GROUP toggle switch, near the Signal Control Selector, to the "A" and "B" positions and verify that there is an A or B display that corresponds to the switch position and a three digit readout.

4.213 ITE-5422 Master Test Encoder and the ITE-5423 200 Circuit Encoder tests will insure that the numbering format controls of the Encoders are functioning properly. The method for testing the system to automatically scan a group of circuits utilizing the ITE-5422 Master Test Encoder is described in Paragraph 4.214.

Step 1: Repeat Steps 1a and 1b and 2a of Paragraph 4.212 using either the ITE-5422 Master Test Encoder or the ITE-5423 200 Circuit Encoder.

Step 2: a) Starting with Zone 1 (000-199) selected on the ZONE selector switch of the Format Section of the Encoder, probe the contacts of the input connectors and verify the display with Table B.

b) Advance the ZONE selector switch to the next zone (Zone 2) and repeat the procedure outlined in Step 2a. Verify all five Zones in this manner.

Table B

ENCODER NUMBERING FORMAT

Connector	Zone 1	2	3	4	5
L1	00X-04X	20X-24X	40X-44X	60X-64X	80X-84X
R2	05X-09X	25X-29X	45X-49X	65X-69X	85X-89X
L3	10X-14X	30X-34X	50X-54X	70X-74X	90X-94X
R4	15X-19X	35X-39X	55X-59X	75X-79X	95X-99X

Step 3: a) While applying the probe to an input contact, operate the GROUP selector switch to the "A" and "B" positions and verify that an A or B display appears and corresponds to the position selected.

b) Set the selector switch to the "A/B" (split group) positions. Probe the contacts of connectors L1 and R2 and verify that the display range is A000-099. Probe connectors L3 and R4 to verify that the display is in the B000-099 range. Regardless of the Zone selected the display should not change in the split mode.

4.214 ITE-5422 Master Test Encoder Automatic Scan Function Tests will insure that the System will automatically scan a group of circuits using the ITE-5421 Analyzer, ITE-5422 Master Test Encoder, and an ITE-5423 200 Circuit Encoder or ITE-5424 1000 Circuit Encoder.

Step 1: Interconnect the ELVS in the following manner (refer to Figure 10):

a) Interconnect the "MP" Connector of the Encoder Input Section of the Analyzer to an "M" connector of the Output Section of the Master Test Encoder. Use an ITE-5421, Detail 1 Interconnect Cord for this interconnection.

b) Interconnect the remaining "M" jack of the Output Section of the Master Test Encoder to an "M" jack of an ITE-5423 200 Circuit Encoder or ITE-5424 1000 Circuit Encoder. Use an ITE-5421, Detail 1 Interconnect Cord for this interconnection.

c) Interconnect the L1 connector of the Input Section of the Master Test Encoder to the L1 Connector of the Input Section of the ITE-5423 200 Circuit Encoder. If an ITE-5424 is used, be sure that the L1 Connector of Zone 1 is selected.

Step 2: Set the ITE-5421 Analyzer controls as follows:

a) DISPLAY CONTROL - Set all Decade Selector switches (HUNDREDS, TENS and UNITS) to the "N" positions. Set GROUP switches A and B to ON.

b) ALARM - Set the TEST MODE Selector switch to SHORTS. Set LATCH to OFF.

c) Power - Verify that the PULL ON switch is in proper position.

Step 3: Set the ITE-5422 Master Test Encoder controls as follows:

a) SCAN CONTROL - Set the SCAN RATE potentiometer approximately at midrange between MIN and MAX. Set the PRESET selector switch to END POINT 1 and the SCAN LIMIT thumbwheel switch to "049".

NOTE: The ITE-5421 Detail 2 interconnect Cord that is used as the "Cable Under Test" contains 50 conductors, 000-049.

b) Format - Set the ZONE RANGE selector switch to "1" (000-199) and the GROUP switch to "A".

Step 4: Set the ITE-5423 200 Circuit Encoder or the ITE-5424 1000 Circuit Encoder as follows:

a) Format - Verify that the ITE-5421 Detail 2 Interconnect Cord is plugged into L1 and ZONE 1 (000-199) if the ITE-5424 is used or set the ZONE RANGE selector switch to "1" (000-199) if the ITE-5423 is used. In both cases, set the GROUP switch to the "B" position.

Step 5: a) At the Master Test Encoder Scan Control Section, momentarily depress the RESET button. Next, momentarily operate STEP toggle switch and observe that a readout of $\frac{A}{B}$ 000 appears in the display window. Each operation of the STEP switch will advance the display one digit i.e., $\frac{A}{B}$ 000,001,002.....

b) Momentarily operate the RESET button. Then operate the toggle switch to SCAN and observe that the readout will automatically advance or count to $\frac{A}{B}$ 049. The green PASS lamp will light when the SCAN LIMIT (049) set by the thumbwheel switches is reached.

Step 6: a) At the Analyzer, set the TEST MODE selector switch to the VERIFY position. Set LATCH to ON. Operate the SCAN toggle switch of the Master Test Encoder's Scan Control Section to SCAN. Operate that the display will automatically count from $\frac{A}{B}$ 000 to $\frac{A}{B}$ 049. The green PASS lamp will light when the display reaches $\frac{A}{B}$ 049 and the display will be off.

b) Set the SCAN LIMIT thumbwheel to "059" and operate the toggle switch to SCAN. Observe that the display will count past "$\frac{A}{B}$ 049" and stop at "A 050". A steady tone audible alarm will be heard from the Analyser indicating an open condition (the Scan Controller will try to transmit and receive a signal through input "50" of the R2 Connector) for which there is no continuity from the A Encoder to the B Encoder.

c) Depress the RESET button in the Scan Control Section of the ITE-5422 Master Test Encoder. The "$\frac{A}{B}$ 050" display will go off and the steady tone will change to a modulated tone indicating that the Analyzer no longer senses the trouble condition. Operate the LATCH switch of the ITE-5421 Analyzer's Alarm Section to the RESET position and note that the modulated tone is extinguished indicating that the alarm memory has been cleared.

4.3 Setup of Test Equipment

4.31 The appropriate section of Handbook 9 should be available prior to any test setup involving the ELVS. Test Methods pertaining to the equipment required and its application to specific telephone systems are presented in these sections. Refer to Paragraph 1.41 for a list of the applicable sections.

4.32 The appropriate List of ITE-5420 ELVS Test Accessory Set should be obtained from Installation Stockkeeping to properly interface the ELVS with the telephone system to be tested. A further explanation of the Test Accessory Set is provided in Paragraph 2.1 of this section.

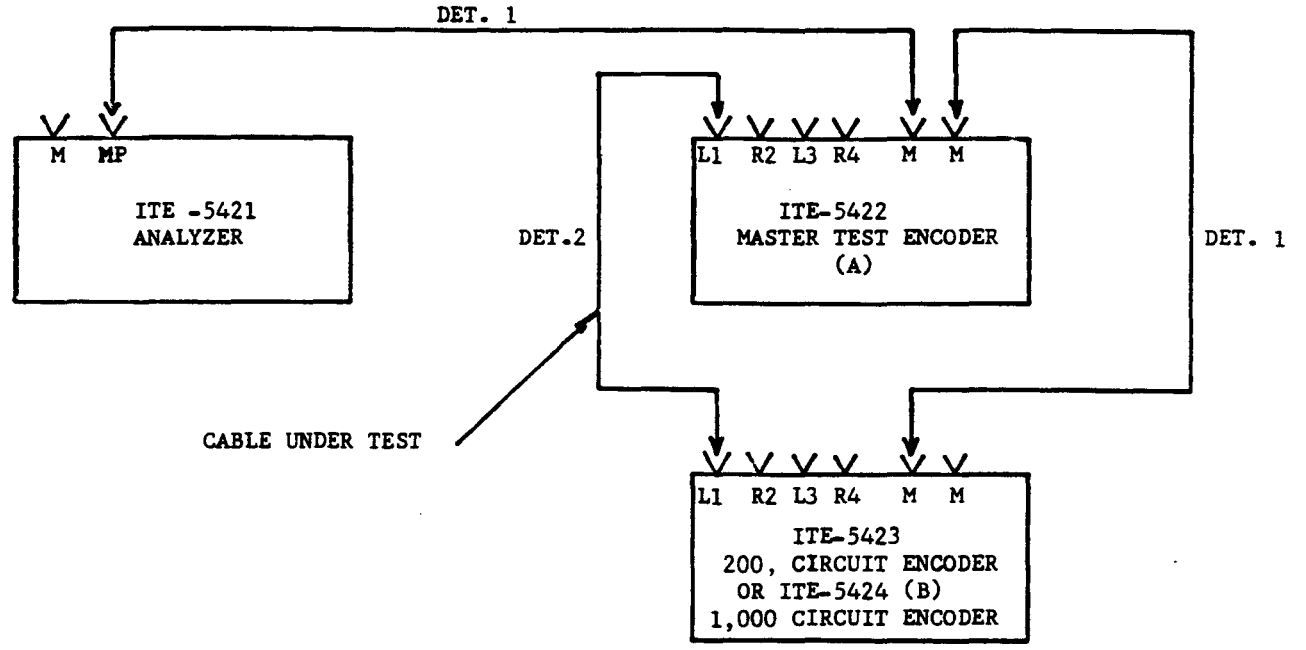


FIG. 10 INTERCONNECT SETUP FOR AUTOMATIC SCAN FUNCTION TEST

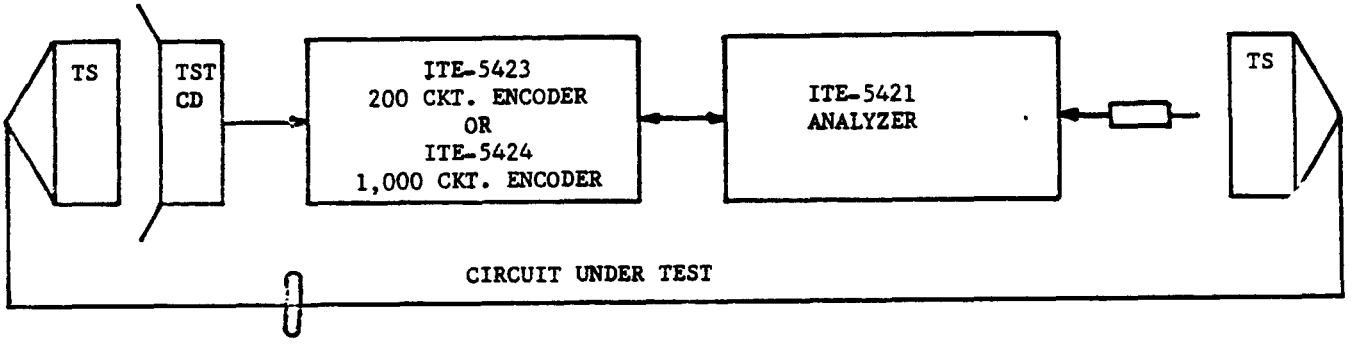


FIG. 11 MANUAL PROBING SETUP

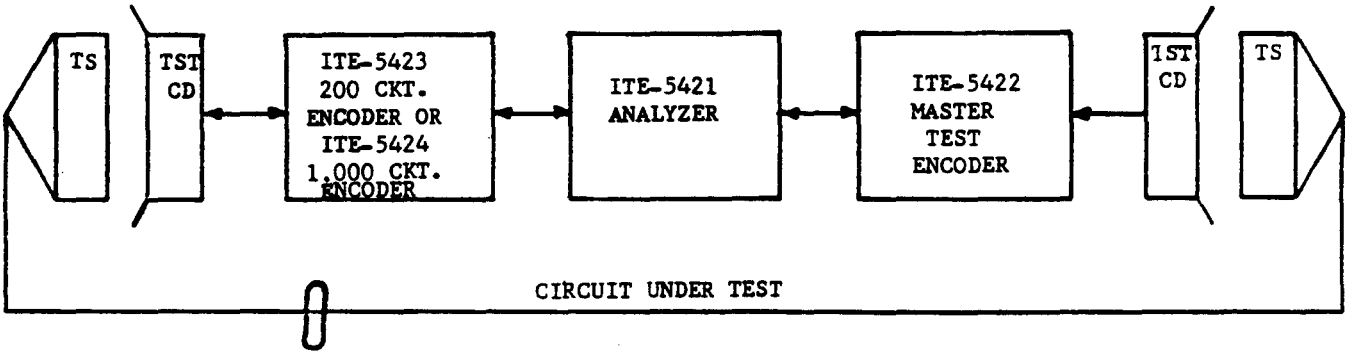


FIG. 12 AUTOMATIC SCAN SETUP

4.33 It is recommended that the installer first follow sequentially the Test Set Operational Tests presented in Paragraph 4.2 before proceeding to set up the ELVS for testing in a multi-floor operation.

4.34 Where testing in a telephone central office requires repeated tests within certain vicinities, and running considerable lengths of ITE-9214 Interconnect Cables between floors, it is recommended that these interconnect runs be left on a temporary basis, if possible, until a time that all testing with the ELVS is completed.

4.341 A description of the ITE-9214 Cables is given in Paragraph 2.11.

4.35 There are basically two test operation setups: Manually Probing (Figure 11) and Automatic Scan (Figure 12). These figures are block diagrams to be used as guides to setup the ELVS in typical manual and automatic situations.

4.36 Further instructions regarding test setup configurations are given in the Handbook 9 sections pertaining to the telephone system to be tested with the ELVS. The basic operating instructions of the ELVS are provided in Paragraph 5.

5. TEST OPERATIONS

5.1 Manual Probing and Automatic Scan

The ELVS will perform two basic test operations, manual probing and automatic scan.

5.11 Manual Probing - In this operation the installer interfaces the terminals at one end of the circuits under test with adapter cords and manually probes with terminals at the other end.

5.111 This operation is to be performed:

(a) When the use of test adapter cords is not feasible on both ends.

(b) For resistance probing circuits that carry resistance shorts.

5.12 Automatic Scan - In this operation the installer interfaces both terminations (origin and destination) of a circuit under test with test adapter cords. The ITE-5422 Master Test Encoder serves as a 200 circuit encoder at one end and controls the test signal distribution for the automatic scanning of a group of circuits, with a 200 lead capacity.

5.121 This operation is to be performed whenever possible under the following conditions:

(a) When the use of test adapter cords on both ends of a circuit are possible.

(b) On leads that are clear of all potential (dry) and to be excluded when an excess of known shorts will make manual probing the most feasible method.

5.2 Resistance Probing (LO-Z)

The resistance probing feature (LO-Z) of the ELVS allows continuity verification of leads that are multipled together through a resistance. Leads may be analyzed through a shunt impedance of 50 ohms or greater to battery or ground. For example, leads that are connected to relay windings, resistance lamps, etc., or that have a common termination through a resistance (Figure 13).

5.21 The ELVS is capable of identifying shorts under 5 megohms of resistance and individual leads shorted with a resistance greater than 50 ohms.

Example:

1) If two leads are shorted together through a resistance greater than 5 megohms it would appear in the Analyzer readout display as a single image or individual lead when probed. This type of short would not be detected with either the HI-Z or LO-Z feature.

2) If two leads were shorted together through a resistance less than 50 ohms, the display would appear as a multiple image with either the HI-Z or LO-Z feature. Only with the LO-Z feature can shorts greater than 50 ohms be separated to a

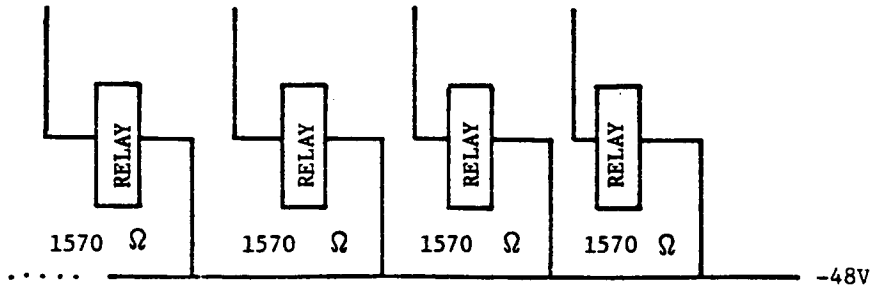


FIG. 13 HOLD MAGNET LEADS CONNECTED IN PARALLEL TO COMMON POINT THROUGH 1570 OHMS IMPEDANCE

single display image. Shorts less than 50 ohms can be considered direct shorts and cannot be separated to a single image under this condition.

5.211 Input circuitry of all Encoders can accommodate potentials of 250 volts AC or DC without causing damage to the ELVS itself.

5.212 Only the ITE-5422 Master Test Encoder and the ITE-5423 200 Circuit Encoder, have the LO-Z feature. Although the LO-Z position is available on the SIGNAL OUTPUT toggle switch of the ITE-5424 1000 Circuit Encoder, this Encoder is to be used for clear or dry circuitry only, and should be operated in the HI-Z position.

5.22 Prepare the ELVS for resistance probing with the following steps:

Step 1: Set up the ELVS to perform a manual probing operation (Figure 11) using the ITE-5421 Analyzer at the terminals to be probed, and either the ITE-5422 Master Test Encoder or the ITE-5423 200 Circuit Encoder at the remote terminals to be interfaced with the ELVS via test adapter cords.

NOTE: If the ITE-5422 Master Test Encoder is used, check that the PRESET selector switch of the Scan Control Section is in the OFF position. The PRESET switch in the END POINT 1 or 2 or SET POINT positions will disengage the IMPEDANCE LEVEL Control at the Analyzer Signal Control Section, thereby preventing resistance probing.

Step 2: At the Analyzer Display Control Section set the GROUP A & B switches to ON. Set the Decade Selectors to the "N" position. The MODE switch may be in the RANDOM or SELECT position, for any probing operation, however, it must be in the SELECT position to analyze a trouble condition.

a) Set the TEST MODE selector of the Alarm Section to the SHORTS position.

b) At the Signal Output Control Section set the SENSITIVITY toggle switch to "HI"; this will permit greater display definition when "tuning out" resistance shorts.

c) Plug the test probe in the BNC PROBE jack and set the SIGNAL OUT toggle switch to LO-Z and the display toggle switch to LOCAL (EXT is to be used for a Remote Readout display).

d) Set the IMPEDANCE LEVEL potentiometer to the maximum clockwise position and probe terminals under test.

5.221 If a resistance short is encountered (between 50 ohms and 5 megohms) an audible tone will be heard and a multiple image will be displayed at the Analyzer.

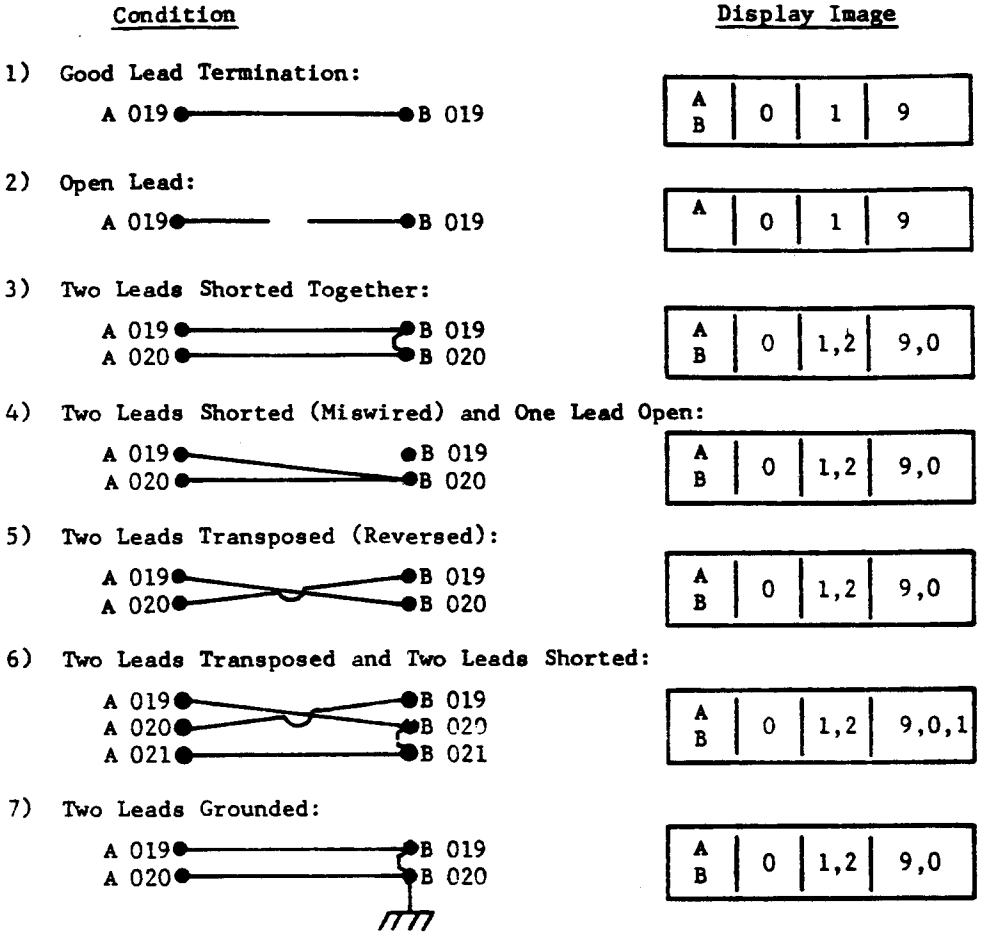


FIG. 14 BASIC TYPES OF CONDITION TROUBLE

5.222 While keeping the probe on the terminals where the short appeared, rotate the IMPEDANCE LEVEL potentiometer in a counterclockwise direction until a single image appears and a modulated tone is heard. This operation has enabled the operator to "tune out" short with the highest resistance, leaving the single image of the lead being probed. The modulated tone indicates that the short is no longer present.

5.223 Due to variable values of the resistances of the shorts encounted, it may be necessary for the operator to adjust IMPEDANCE LEVEL control for a considerable number of the shorts displayed.

5.3 Alarm Test Modes

The ELVS is designed to operate in four alarm test modes (Paragraph 2.231):

1) Search
2) Shorts
3) Verify
4) Coordinates

Figure 14 illustrates the basic types of trouble conditions that may be encountered by the operator during a test operation.

5.31 The SEARCH MODE allows the operator to find a specific lead selected by the DISPLAY CONTROL selector switches on the Analyzer.

5.311 The desired number to be searched is selected on the decade selectors (HUNDREDS, TENS and UNITS) and the MODE switch is set to the SELECT position at the Display Control Section of the Analyzer. When the selected terminal is probed, a steady audible tone is heard and the image of the number along with the alphabetical character (A or B) representing the group is displayed.

5.312 All leads other than the one selected will display two horizontal "short bars" with no alphanumeric image. These leads will not initiate a tone.

5.313 If the "N" position is selected in a decade, the selector circuitry will gate all numbers within that decade that are included in the short, to be displayed with numbers selected on the other one or two selector switches.

Decade Selector Switch Settings

Example	Hundreds	Tens	Units		Display
1	1	2	9	=	129
2	0	5	0	=	050
3	0	N	4	=	004,014,024, 034.....094
4	1	7	N	=	170,171,172, ...173..... 179
5	N	3	6	=	036 & 136 (Hundreds number depends on RANGE selected)

5.32 The SHORTS Mode is used for continuity verification operations when manual probing is the most feasible method of interrogating leads under test (refer to Figure 11 for illustrations of a manual probe operation setup).

5.321 Manual continuity testing using the ELVS is performed by probing the lead terminals under test in a continuing order and verifying that the display image number agrees with the lead terminal number under test.

NOTE: The SENSITIVITY switch at the Signal Control Section of the Analyzer should be set to the "LO" position to avoid false short conditions caused by capacitance while probing terminals that are located close to each other.

5.322 Verify that both GROUP switches (A & B) are "ON". All Decade Selectors must be in the "N" position or the MODE switch must be set to RANDOM. Each terminal probed will display the number of the lead as it is interfaced into the Encoder at the remote end of the circuit or cable under test. The alphabetical character representing the group selected on the remote Encoder will also be displayed.

5.323 A short is indicated by a multiple image display, (such as 14Ø and a steady audible tone. The following steps are to be used to analyze a "short" trouble condition:

Step 1: While maintaining probe contact with the shorted lead operate the MUTE pushbutton of the Analyzer Alarm Section. This action will silence the steady tone.

Step 2: Check the MODE switch is in the SELECT position and rotate the most significant (leftmost) selector that contains a multiple image in its Nixie display. All numbers selected that do not compose part of the total shorted number will produce a blank display with the exception of the two horizontal "short bars". When the number involved in the short is dialed, the display will show the Encoder alphabetical character between the "short bars" preceded by the number involved in the short. The Nixie display pertaining to the selector that is dialed should display a single image. If the short involves lead numbers of a less significant decade, then the operator must "dial the short out", working from left to right until a full single image is displayed.

Illustration

Lead numbers 000, 024, 025 and 100 shorted together project a multiple image display with all of the above numbers appearing simultaneously.

5.324 Wire reversals are indicated by a reversal in the continuing order of the readout display i.e., 043, 044, 046, 045, 047.....

5.325 Open leads will affect no readout image in the display during a manual probing operation.

5.33 The VERIFY Mode is used for continuity verification during an automatic scan operation. In this mode, short circuits, wire reversals, and open circuits will affect an alarm and a display of the trouble condition (Refer to Figure 12 for illustrations of an automatic scan operation setup).

5.331 Verify that both (A & B) GROUP switches are "ON" and that the Analyzer is in the RANDOM Mode either by "N" selected on all Decade Selectors or the MODE switch is in the RANDOM position.

5.332 Set the ITE-5422 Master Test Encoder GROUP switch (Format Section) to the "A" position or "A/B" split group position if operating with 100 leads or less at close origin-destination proximity.

5.333 The remote Encoder may be an ITE-5423 200 Circuit Encoder or an ITE-5424 1000 Circuit Encoder. The remote Encoder should be set to the GROUP "B" position. Verify that the ZONE of both the Master Test Encoder and the remote Encoder agree.

5.334 At the Master Test Encoder, Scan Control Section, set the SCAN LIMIT thumbwheel switch for one less than the total number of leads to be scanned. Set the PRESET selector. switch to the type of scan desired.

1) END POINT 1 - For a one segment sweep starting at 000 to the lead number set the SCAN LIMIT thumbwheel (refer to Paragraph 2.5411 for a further explanation).

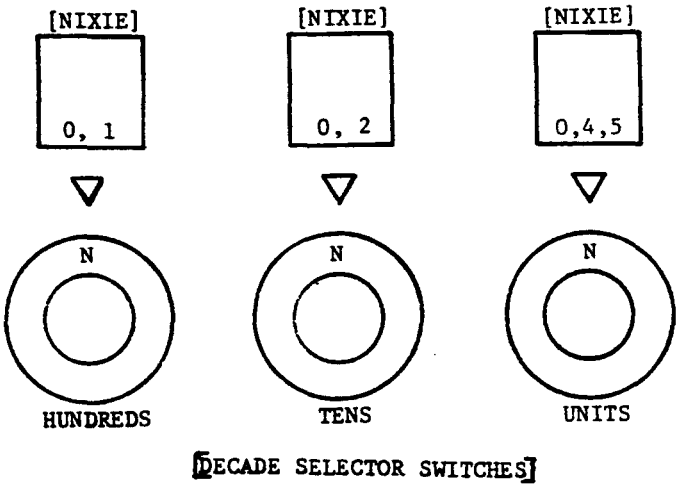
2) END POINT 2 - For a two segment sweep starting at 000 to the "Row" and "Column" number set on the thumbwheels for the first segment and the second segment starting at the higher hundreds number set on the ZONE LIMIT thumbwheel. The ZONE LIMIT will always be set to 1 in the End Point 2 scan, however, this number is represented by the higher number of the ZONE RANGE set by the ZONE switch in the Format Section. (Refer to Paragraph 2.5412 for a further explanation.)

3) SET POINT - For an instantaneous advance to the number set on the SCAN LIMIT thumbwheel switch. When the toggle switch is operated to the SCAN position, the number selected is displayed and a continuous test signal is applied to the lead displayed. Each operation of the toggle switch to the STEP position will advance the signal and display to the next higher numbered lead. (Refer to Paragraph 2.5413 for a further explanation.)

5.3343 To begin scanning, set the SCAN RATE potentiometer for the desired scan speed, depress the RESET button and operate the toggle switch to the SCAN position.

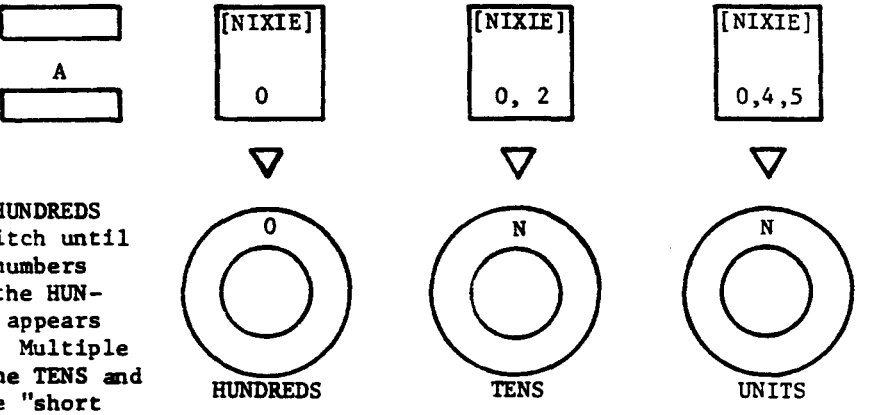
5.335 Scanning a group of leads where there are no trouble conditions, the display image will count from 000 to the number selected on the SCAN LIMIT thumbwheel switch. When the scan limit is reached the display will go off and the green PASS lamp will be lit on the Master Test Encoder.

[GROUP INDICATOR] A

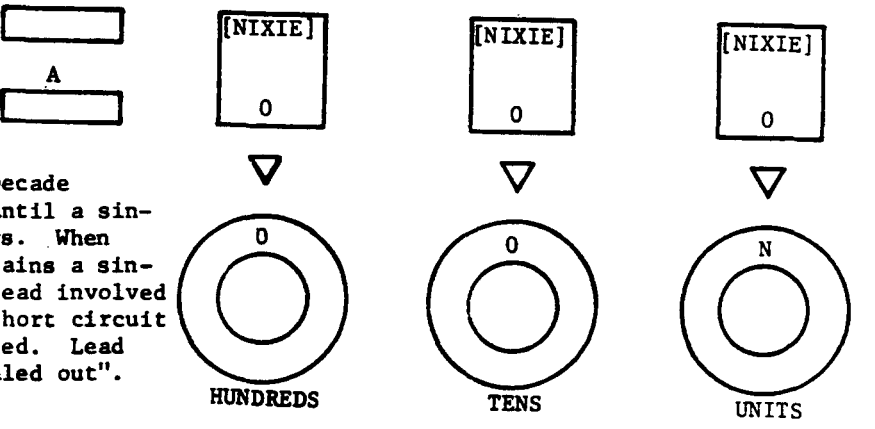


Step 1: The initial display conditions are superimposed numbers in each display tube ("Nixie") and the "A" Group indicator lighted. Set the MODE Switch to SELECT.

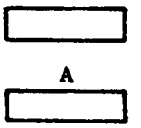
[SHORT BARS]

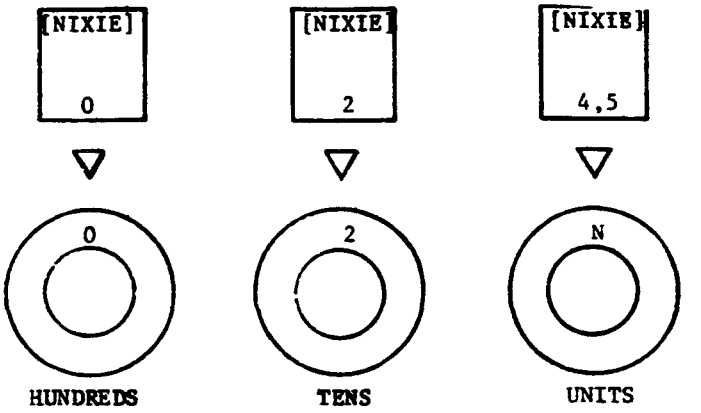


Step 2: Slowly rotate the HUNDREDS Decade Selector switch until the lowest of the numbers which appeared in the HUNDREDS display tube appears as a single image. Multiple images remain in the TENS and UNITS display. The "short bar" neon indicators will light and the "A" Group indicator will remain lighted.

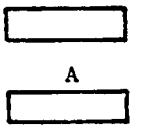


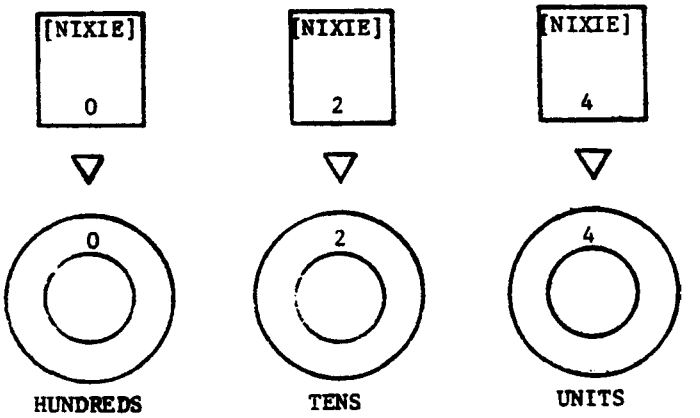
Step 3: Rotate the TENS Decade Selector switch until a single number appears. When each display contains a single number, one lead involved in the multiple short circuit has been identified. Lead 000 has been "dialed out".



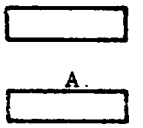


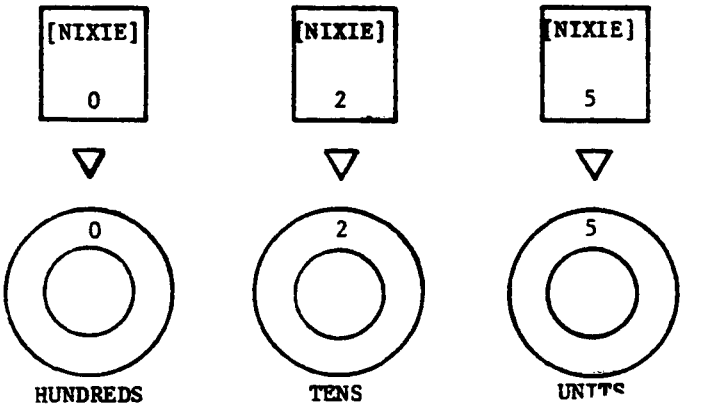
Step 4: Continue to rotate the TENS Decade Selector switch until the next single number appears in the TENS display. A multiple image remains in the UNITS display.



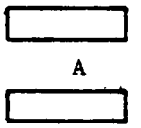


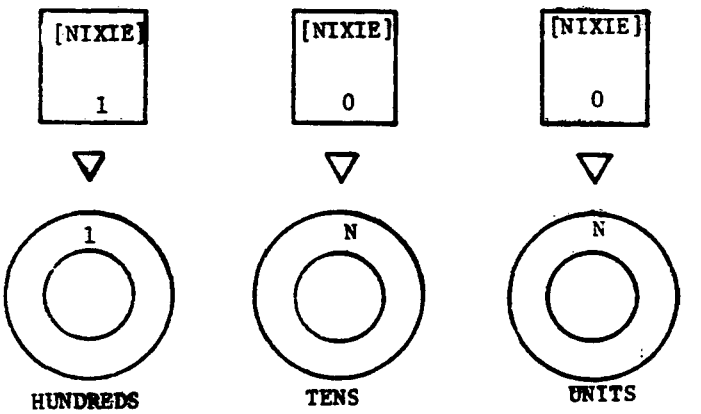
Step 5: Rotate the UNITS Decade Selector switch until a single number appears in the UNITS display. When each display contains a single number, another lead involved in the multiple short circuit has been identified. Lead 024 has been "dialed out".





Step 6: Continue to rotate the UNITS Decade Selector until the next single number appears in the display. Lead 025 has been dialed out. All leads between 000 and 099 which are involved in the multiple short circuit have been identified.





Step 7: To identify leads between 100 and 199 which are involved in the multiple short, reset the TENS and UNITS Decade Selectors to "N" and rotate the HUNDREDS Decade Selector to the "1". Lead 100 is identified as part of the short circuit.

5.3351 Any trouble conditions will cause the red FAIL lamp to light.

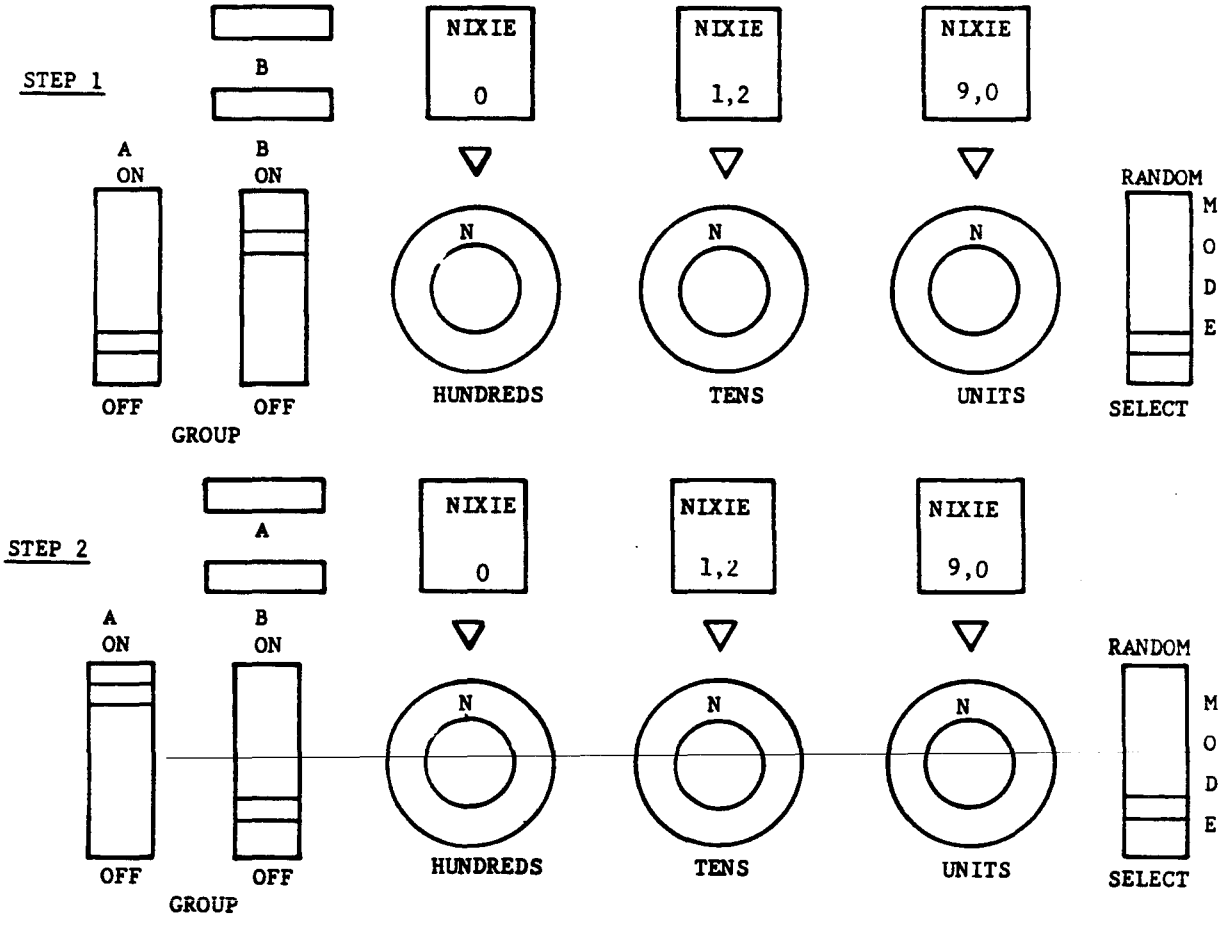
5.336 A short condition indicator will cause a steady tone and the stopping of the automatic scan process at the first lead with a short that is scanned. The display image will appear in the same manner as it does in a manual probing operation except that the A and B Group lamps will display if the lead is not open, i.e., A B 011 indicating that leads 011 and 012 are shorted together.

5.3361 A short will affect a display image the same as that of a reverse. It is necessary for the operator to operate the A and B GROUP switches in order to diagnose the trouble condition. The alphabetical indication of the opposite group and the multiple number image will remain as each GROUP switch is set to the OFF position while the opposite GROUP switch is set to the ON position.

Illustration

Leads 019 and 020 are shorted together.

5.3362 When the trouble condition is determined the shorted leads are "dialed out" in the same manner described in Paragraph 5.323.

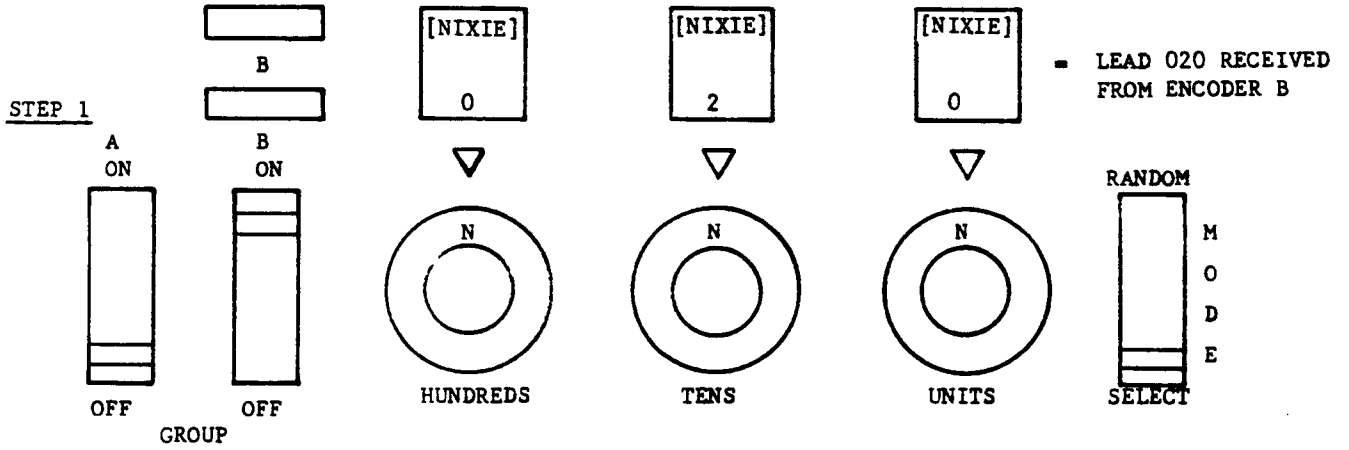


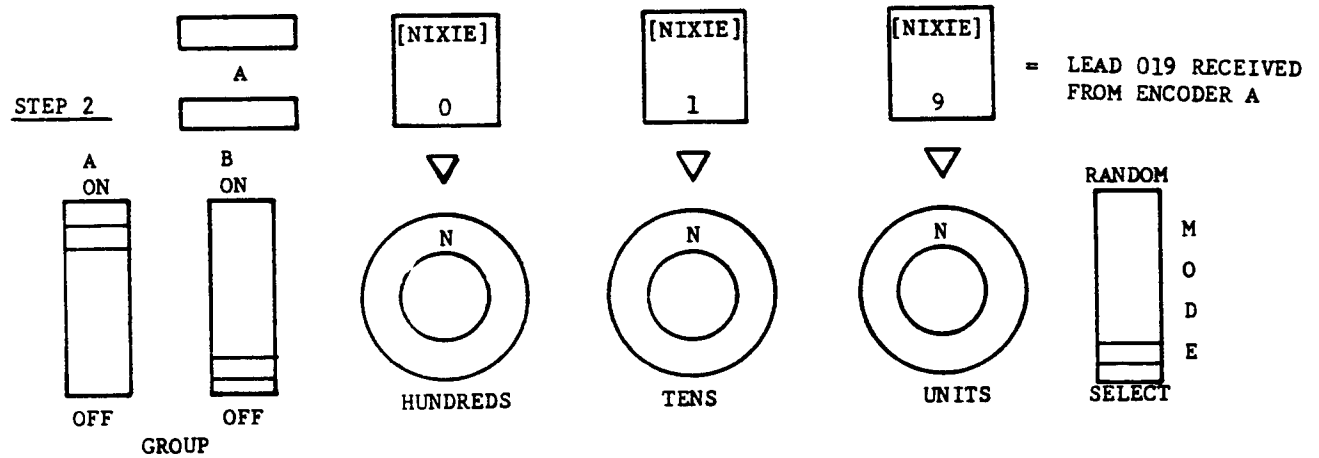
5.337 The ELVS will report wire reversals while scanning in the VERIFY Mode. It is necessary for System to be interfaced at both ends with the circuit or cable under test. This may be referred to as an "origin - destination" test, the "A" Encoder reports conditions at the point of the circuit origin while the "B" Encoder reports conditions at the destination or remote end of the circuit.

5.3371 As stated previously, wire reversals affect a display similar to that of a short condition, in this case the image would be doubled, making it necessary for the operator to utilize the A and B GROUP switches to determine the trouble condition. The alphabetical indication of the opposite group and a single number image will appear as each GROUP switch is set to the OFF position while opposite Group switch is set to the "ON" position.

Illustration

Leads 019 and 020 are reversed.

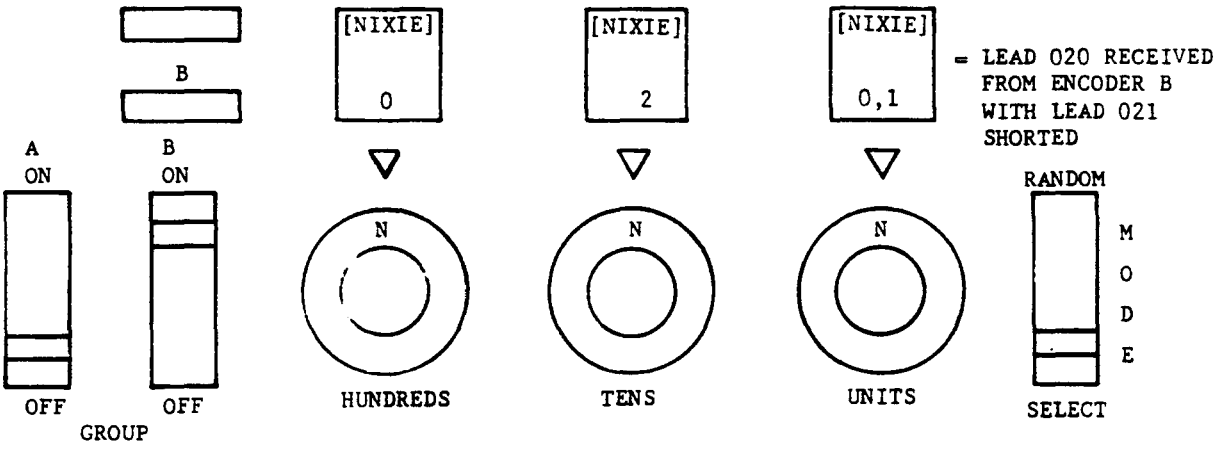




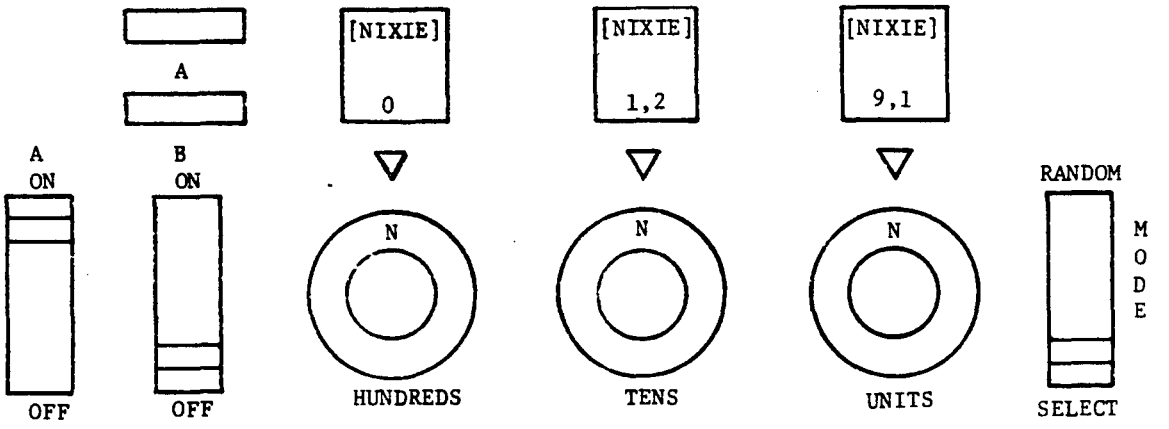
5.3372 **Leads involved in a reversal that are shorted to other leads (wire reversal and short circuit) would appear as a double or multiple image. The image of the shorted lead would appear when the Scan Controller applies the test signal to the lead involved in the reversal that is in contact (shorted) with another lead.**

Illustration

Leads 019 and 020 are reversed and 020 is shorted to 021 presenting a double image in the TENS Nixie tube and a triple image in the UNITS Nixie tubes. Refer also to Figure 14 Condition 6.



Step 1: Turn the "A" Group switch OFF. The double image remaining in the UNITS display tube indicates two leads shorted together which can be identified by "dialing out" with the UNITS Decade Selector as described in Paragraph 5.323.



Step 2: Return the "A" Group switch to the ON position. Turn the "B" Group switch OFF. The double image indicates shorted leads which can be dialed out. The 021 read on the A Encoder is caused by the test signal feedback through lead 021; although it is shorted to 020, it is correctly terminated from A021 to B021.

5.338 Open circuit conditions will be detected by the ELVS while scanning in the VERIFY mode. With an "origin - destination" test arrangement, the System will report an open circuit when it is unable to receive the test signal applied by the Scanner Controller.

5.3381 The scanning process will stop on a lead that is open. The display will be a single image number preceded by A or B (not both) indicating the Group designation of the Master Test Encoder.

Illustration

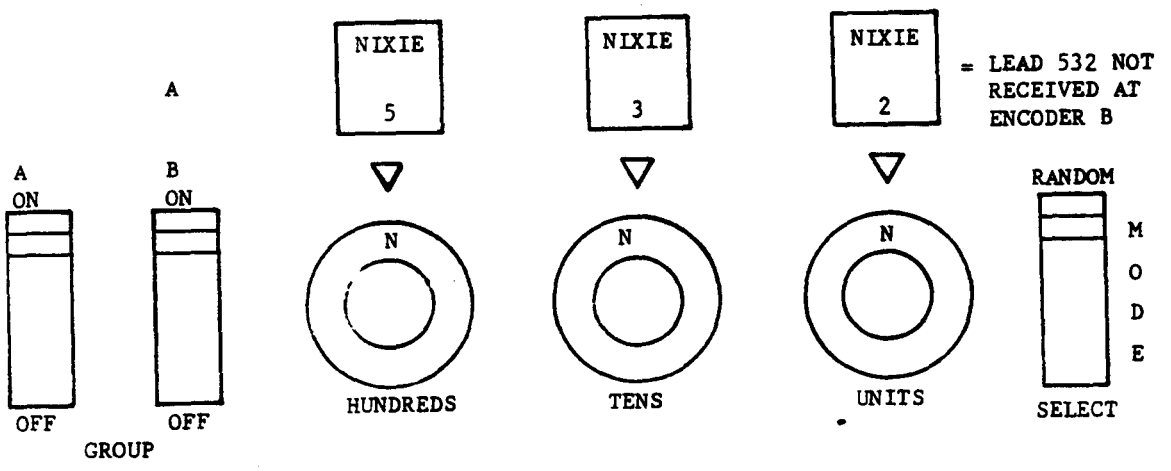
Lead 532 (Zone 3) is open.

5.34 The COORDINATE Mode may be used for automatic scanning of circuitry where known conditions exist on the leads under test and the selection of alarm conditions is desirable.

5.341 The system will report alarm conditions with the following toggle switch settings:

1) COLUMNS - Reports multiple image conditions in the UNITS Nixie display.

2) ROWS - Reports multiple image conditions in the TENS Nixie display.



5.4 Test Control Settings

The proper control settings of the ITE-5421 Analyzer and the ITE-5422 Master Test Encoder are provided here to aid the operator in the test setup.

5.41 Table C indicates the control settings for the ITE-5421 Analyzer.

5.42 Table D indicates the control settings for the ITE-5422 Master Test Encoder.

6. TEST SET TROUBLE CONDITIONS

This paragraph is provided to aid the installer in trouble shooting and in making minor corrections to the ELVS at the installation site.

6.1 Open Indications

Open circuit conditions can occur within the ELVS interconnect cables (ITE-5421 Details 1 & 2 and ITE-9214). These conditions may be caused by open leads within the interconnect cables or by a poor connection between the cable plug and the test set connector.

6.11 The interconnection cables provide the flow of data between the integral components (Analyzer and Encoders) of the ELVS. These cables plug into the "M" connectors at the Encoders and the "M" or "MP" connectors at the Analyzer.

6.12 Trouble indications resulting from faulty interconnections within the ELVS can vary from:

1) One or more display indicators or the total display being inhibited.

2) Multiple images.

3) Inhibited alarm system.

6.13 The following actions may reveal the cause or remedy open circuit conditions:

1) Check that each connection is tight.

2) Inspect all plugs and connectors for dirt or other contaminations.

3) If necessary, perform a continuity test on the interconnect cables using the ELVS (this procedure is described in Paragraph 4.214). If the above method is not practical, perform a continuity test on the interconnect cable with a buzzer or voltohmmeter.

NOTE: All interfacing devices, such as plugs and connectors, should be cleaned periodically with KS-20406-L1 Cleaner, Spray to prevent contamination.

6.14 Test adapter cords (ITE-9215-9225) should be verified in the same manner as interconnect cables if a test trouble condition consistently repeats over a number of circuits under test.

6.15 A faulty Program Plug connection in the "P" Connector of the Analyzer will cause trouble conditions similar to those described as a result of a faulty system component interconnection.

6.151 The readout display may project an erroneous image in a manual operation, or what appears to be counting in reverse during an automatic scan operation, if the ITE-5421 Detail 4 Reverse Program Plug is inadvertently installed into the "P" Connector. The Detail 4 Plug is designed to allow the changing of terminal strip numbering assignments depending on a front or rear test adapter insertion.

6.2 Fuse Replacement

One or both of the battery fuses located within the ITE-5421 Analyzer may blow as a result of a condition caused at the test site. These fuses may also be subject to damage or jarring loose during transit.

6.21 A defective "Battery 2" fuse will cause an indication of no power (failure to display) within the ELVS, whereas "Battery 1" fuse affects the LO-Z feature circuitry.

6.22 Both fuses (1 & 2) can be tested using the BATT TEST switch and indicator located on the Analyzer.

TABLE C

ITE-5421 ANALYZER CONTROL SETTINGS

Test Operation/ Mode	Display Control Section			Alarm Section			Signal Control Section					EXT/ LOCAL	Impedance Level
	Group A & B	Decade Selectors	Mode	Volume	Latch	Test Mode	Sensitivity	(Ground)	Signal Level	Probe Jack	LO-Z/ HI-Z		
Manual: Search	On	Note A	Select	Mid Range	---	Search	HI	Note B	Max	HI-Z or BNC	HI-Z	---	---
Shorts		All Set to "N"			On	Shorts	LO					---	---
Coordinate						Coordinate Row/Column	HI					---	---
Resistance Probing						Shorts	HI		---	BNC	LO-Z	LOCAL	Max
Ground Detecting						Off	---	⏚	Max	---	---	---	---
Verify	Note C												
Automatic: Shorts	On	All Set to "N"	Select	Mid Range	On	Shorts	HI	Note B	Max	---	---	---	---
Verify						Verify				---	---	---	---
Coordinates						Note D				---	---	---	---

NOTES:

A Set the Hundreds, Tens and Units Selectors to the number to be searched (000-999).

B Set the toggle switch to the up position (or opposite the ground symbol).

C The Verify Mode is to be used during an automatic scan operation when the points of origin and destination of the circuit under test are interfaced into Encoders.

D The ROW position of the ROW/COLUMN switch causes the alarm to signal only multiple images in the TENS display tube. In the COLUMN position, the alarm signals only multiple images in the TENS display tube.

TABLE D

ITE-5422 MASTER TEST ENCODER CONTROL SETTINGS

Test Operation/ Mode	Input Section				Format Section		Scan Control Section				Signal Output Section		
	L1	R2	L3	R4	Zone	Group	Scan Limit	Preset	Scan/ Step	Scan Rate	Spare Jack	Probe Jack	HI-Z/LO-Z
Manual:													
Search	Note A	Note B	Note A	Note B	Note C	Group A	---	Off	---	---	Note D	---	---
Shorts	↓	↓	↓	↓	↓	↓	---	↓	---	---	↓	---	---
Coordinate	↓	↓	↓	↓	↓	↓	---	↓	---	---	↓	---	---
Resistance Probing	↓	↓	↓	↓	↓	↓	---	↓	---	---	↓	---	---
Ground Detecting	↓	↓	↓	↓	↓	↓	---	↓	---	---	↓	---	---
Verify	Note G												
Automatic:													
Shorts	Note A	Note B	Note A	Note B	Note C	Group A	Note E	Note F	Note G	Mid Range	Note D	---	---
Verify	↓	↓	↓	↓	↓	Note H	↓	↓	↓	↓	↓		

NOTES:

A Connectors L1 and L3 encode numbers X00-X49 (X represents the Zone Limits of the Zone selected).

B Connectors R2 and R4 encode numbers X50-X99 (X represents the Zone Limits of the Zone selected).

C Select Zone Range of 200 numbers (Zone 1, 000-199 to Zone 5, 800-999).

D Use for talk path to remote encoder if necessary.

E Set to highest number of lead, within Zone, to be scanned (000-199, a total of 200 leads).

F Set "END POINT 1" to scan in one sweep 200 leads or less or "END POINT 2" to scan in two sweeps of 100 leads or less. "SET POINT" will apply test signal and display number selected.

G Operate to "Scan" for normal automatic testing and operate to "Step" to observe trouble indications or step over trouble conditions.

H Set to "A" on local Encoder (nearest Analyzer) and "B" on remote Encoder. If testing 100 leads or less when origin and destination are within close proximity, the Master Test Encoder may be used in the "A/B" split group position.

With the ITE-5421 Detail 5 Power Cord connected, pull the power switch (PULL ON) to the ON position. Operate the BATT TEST toggle switch to the "1" position and observe that the needle of the BATT TEST indicator has deflected from the red area to the white. Repeat for the other battery by operating the toggle switch to the "2" position.

6.221 Failure of the needle to deflect to the white area during the battery test indicates a blown fuse.

6.23 Replace defective fuses as follows:

Step 1: Using a 3/32" Socket Screw (Allen) Wrench, remove the four Socket Head Screws located at each corner of the Analyzer faceplate.

Step 2: Carefully lift the Analyzer chassis from the carrying case by the handles located at each side of the faceplate. Use caution not to damage the loose wire forms within the chassis assembly.

Step 3: Place the chassis with the faceplate up, on a level surface.

Step 4: The two ITE-4431V 1/4 Amp "Slo Blo" glass cartridge fuses are located on a 6" x 3-1/4" circuit board at the bottom left area of the chassis (Signal Output Section of faceplate towards operator). Fuse "F1" is located vertically in a fuse holder on the right side of the circuit board. Fuse "F2" is located horizontally in a fuse holder on the left side of the circuit board. These fuses can be removed and inserted by hand. They can be tested for continuity with a voltohmmeter if necessary.

6.231 Due to transients such as line surge, it may become necessary to replace the AC line fuse located on a terminal strip at the bottom left rear of the chassis, next to the line transformer.

6.232 The AC line fuse is a pigtail 1/4 Amp "Slo Blo" glass cartridge fuse encased in heat shrinkable tubing and wired to the terminal strip. This fuse can be tested for continuity by testing across the wired terminals with a voltohmmeter.

CAUTION:	BE SURE THAT THE ANALYZER IS NOT CONNECTED TO AN AC LINE PRIOR TO ANY MAINTENANCE WORK WITHIN THE CHASSIS.

6.233 AC line fuse replacement will require connecting wires from the replaced fuse to the terminal strip. The exposed fuse must be protected with 1/2" Gray Plastic Tape (R-3359) after replacement.

6.3 Connector Replacement

Connectors located on the Analyzer and Encoders of the ELVS are subjected to considerable wear due to the constant insertion and disconnecting of test adapters and interconnect cable plugs. These connectors are easily replaceable in the event that a connector becomes worn to the degree that it no longer functions properly.

6.31 All KS-16672-L3 type connectors have been modified to provide a "plug-in" feature. This feature avoids costly rewiring when connector replacement becomes necessary.

6.312 Remove worn connectors from the test set faceplate by removing the two Socket Head Screws, located at each end of the connector, using an .050" Socket Screw (Allen) Wrench. The worn connector is then unplugged and the replacement connector is plugged into its place and secured with the Socket Head Screws.

NOTE: Connector contact No. 1 must be at the upper left of the connector and towards the upper left corner of the faceplate when inserted.

6.314 Replacement connectors will be available through Installation Stockkeeping.

6.4 Display ("Nixie") Tube Replacement

Display ("Nixie") tube replacement may become necessary if any one of the "Hundreds", "Tens" or "Units" tubes fail to display. Failure of these tubes can be caused by mishandling of the Analyzer or if the tube no longer functions due to use past its life expectance.

6.41 The display tubes are accessible for replacement by following the procedure in Paragraph 6.23 Steps 1 through 3.

6.411 The three tubes, located behind the display window, are plugged into sockets that are connected to a circuit board.

6.412 If a condition exists when one tube is defective and no immediate replacement tube is available, it is possible to insert the defective tube in, or leave open, the "Hundreds" socket. This action will enable the operator to test 100 leads at a time numbering from 000-099.

6.413 Display tube replacements will be available through Installation Stockkeeping.

6.5 Battery Replacement

Batteries that have undergone a considerable length of service or have been subjected to repeated deep discharges may become defective while on the installation site.

6.51 Power for all components within the ELVS is supplied by four (6 Volt, 2.6 Ampere hour "Gel/Cell") rechargeable batteries. These batteries are located on the chassis base of the ITE-5421 Analyzer in two groups of two batteries, connected together in series. Each battery group (Battery 1 and Battery 2) has an output of 12 Volts.

6.52 Both batteries (1 & 2) can be tested with the BATT TEST switch and indicator located on the Analyzer faceplate. With the power cord disconnected repeat the procedure described in Paragraph 6.22.

6.521 Failure of the indicator needle to deflect to the white area during this test indicates a dead battery or a blown fuse.

6.522 Slight deflection of the needle within the red area indicates that the battery is low and recharging is required. The batteries are recharged by connecting the power cord from the CHARGER connector to an AC line. The On-Off power switch may be in either position during charging and overcharging is not possible.

6.523 The batteries are considered defective when they can no longer maintain a charge. The BATT TEST indicator needle should deflect to the white area after approximately 12 hours of charging.

6.524 Contact Installation Stockkeeping to determine the disposition of the test set when batteries are found to be defective.

6.6 Other Conditions

In event that a trouble condition arises that is not covered herein contact Installation Stockkeeping to determine the proper action to be taken.

Engineering Planning Manager
Common Installation Engineering