# *TELETONE** M-164-71 *CONVERT-A-PACK* †

# TONE-TO-PULSE CONVERTER

# STEP-BY-STEP SYSTEMS

## 1. GENERAL

**1.01** This section is a cover sheet for the Teletone M-164-71 Convert-A-Pack instruction, Section 164-171. GAEL 1925 authorizes the use of this equipment in Pacific Company.

**1.02** (Reserved for future use)

**1.03** The M-167-71 tone-to-pulse converter (TPC) is a solid-state device which is used in step-by-step (SXS) offices to convert *Touch-Tone*® signals to dial pulses and can be used in combination rotary dial and *Touch-Tone* groups.

**1.04** The TPC can be used with one or two party lines with or without ANI and multi party lines. TIP party identification (ANI) forwarding is provided on two party lines. A time-out feature of 16 seconds starts when the first *Touch-Tone* digit is received and is reset with each succeeding digit. In addition, a dial pulse release feature inhibits the unit when rotary dial pulses are detected.

**1.05** The M-164-71 unit is completely compatible (pin for pin) with previously standardized TPC units connecting cable harnesses (ATC Part Numbers 100342-4, 5, and 8). This unit can be used as a direct replacement for existing TPCs also removed and reapplied in other SXS offices as needs dictate.

**1.06** Due to the effects that nonprecise dial tone may have on the converter, it is necessary to limit their installation to offices equipped with precise dial tone.

*Note:* In SXS offices, it should be noted that if *Touch-Tone* subscribers wish end-to-end signaling, a polarity guard kit must be installed in the subscriber's *Touch-Tone* set.

**1.07** If corrections are required in the manufacturer's instruction, use Form E-3973-1PT as described in Section 000-010-901PT to process the correct information.

**1.08** If equipment design and/or manufacturing problems should occur, refer to Section 010-700-011PT for procedures on how to file an Engineering complaint for General Trade Products (GTPs).

**1.09** When revised instructions reflect changes due to modification of equipment, retain the superseded information until equipment is modified.

*Note:* Equipment shall *not* be modified without approval of the Equipment Maintenance Engineer.

## 2. TRAINING

**2.01** A formal training package on this equipment is not contemplated as no repair work is to be performed by TELCo maintenance forces. Should a training need develop, a request should be directed to the Engineering Staff Director-Switching.

## 3. MAINTENANCE

**3.01** Field repairs that involve replacement or modification of components within this unit are not recommended.

**3.02** ***Under no condition are field repairs to be attempted.*** To do so renders the warranty null and void.

**3.03** Installation, testing, and troubleshooting procedures for the M-164-71 converter are included in the attached Teltone section.

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## 4. ORDERING PROCEDURES

**4.01** Order Teltone equipment direct from the manufacturer:

Teltone Corporation
10801 - 20th Avenue N.E.
Kirkland, WA 98033

**4.02** Detailed ordering information is covered in GAEL 1925 and the GTP Catalog.

## 5. REPAIR/RETURN

**5.01** Teltone provides a factory repair service for the converters. All defective units must be returned to the Teltone factory for repair. Factory turn around time is 10 working days for repairs.

**5.02** A Teltone repair request card must be filled out and accompany the unit(s) being returned for repair. Returned unit(s) are to be shipped transportation prepaid to:

Teltone Corporation
10801 - 20th Avenue N.E.
Kirkland, WA 98033

**5.03** Teltone equipment has a warranty period of 4 years from the date of delivery. The warranty on repaired units is for the remainder of the original warranty or 90 days, whichever is longer.

*Note:* A flat rate repair charge of $15.00 per unit will be made for units that require repair *after* the warranty has expired.

*Attachment:*

Teltone Corporation, Technical Practice; Section 164-171, Issue 2, January, 1979

# M-164-71* CONVERT-A-PAK T.M.

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## 1. GENERAL

1.01 This technical practice applies to TELTONE M-164-71* CONVERT-A-PAK™ tone-to-pulse converters (see Figure 1). Descriptions, ordering information, installation procedures, and troubleshooting procedures are provided.

1.02 This practice is reissued to include information on the Dial Pulse Release feature. Paragraphs 2.01, 3.09, 5.04, 5.06, 7.12 and Part 9, cover this information.

1.03 The installation procedures in this practice are condensed into Installer's Aid 164-271. The Installer's Aid provides an itemized checklist for installation and testing.

## 2. CONCEPT

2.01 The M-164-71 is a dedicated DTMF receiver that converts DTMF digits one through zero to equivalent trains of rotary-dial type pulses. The M-164-71 is packaged to mount directly on the back of a switch rack and does not require additional floor space. The unit is designed for direct control (step-by-step) central office conversions. The following design features are provided.

- Installation requires connecting only the Tip and Ring pair leads and the battery and ground leads (see Figure 2).
- Tip party identification (ANI) forwarding is provided.
- Line split does not occur until the signal has been verified as a valid digit and has ended: this avoids having the line split by spurious noise.
- Answer supervision inhibits the unit.
- The 16-second Time-Out starts when the first DTMF digit is received.
- The Dial Pulse Release inhibits the converter to assure that it does not remain enabled for rotary dial calls.
- The End of Dialing feature inhibits the converter from recognizing any digits following a DTMF * or # signal.

## 3. GENERAL DESCRIPTION

3.01 The M-164-71 provides dedicated tone-to-pulse conversion with a single unit for each linefinder. Any DTMF digit from one to zero is converted to a series of break pulses like those produced by a rotary dial telephone. The fixed interdigital time of the conversion decreases the total dialing time compared to a manually operated rotary dial instrument.

3.02 As is shown in Figure 3, a DTMF tone pad signals a given digit with two out of seven available frequencies. The M-164-71 detects and translates these two-of-seven frequencies signals as they appear on its Tip and Ring IN leads. It then outpulses the corresponding number of break pulses to the forward switching equipment wired to its Tip and Ring OUT leads.

3.03 The M-164-71 is packaged in a thermal plastic housing as shown in Figure 1. The housing meets UL94 V-0 requirements. The M-164-71 includes all the interface circuitry, logic elements, and DTMF receiver functions to convert one linefinder or selector. The unit operates on the same -48 volt battery supply as other telephone equipment.

3.04 In the idle state, when it is monitoring line conditions, the unit typically draws 70 ma (milliamperes). From detection of off-hook until the unit is released, the M-164-71 typically draws 90 ma, except during outpulsing when the line is split; the M-164-71 then draws additional current for the battery feed connected to Tip and Ring IN.

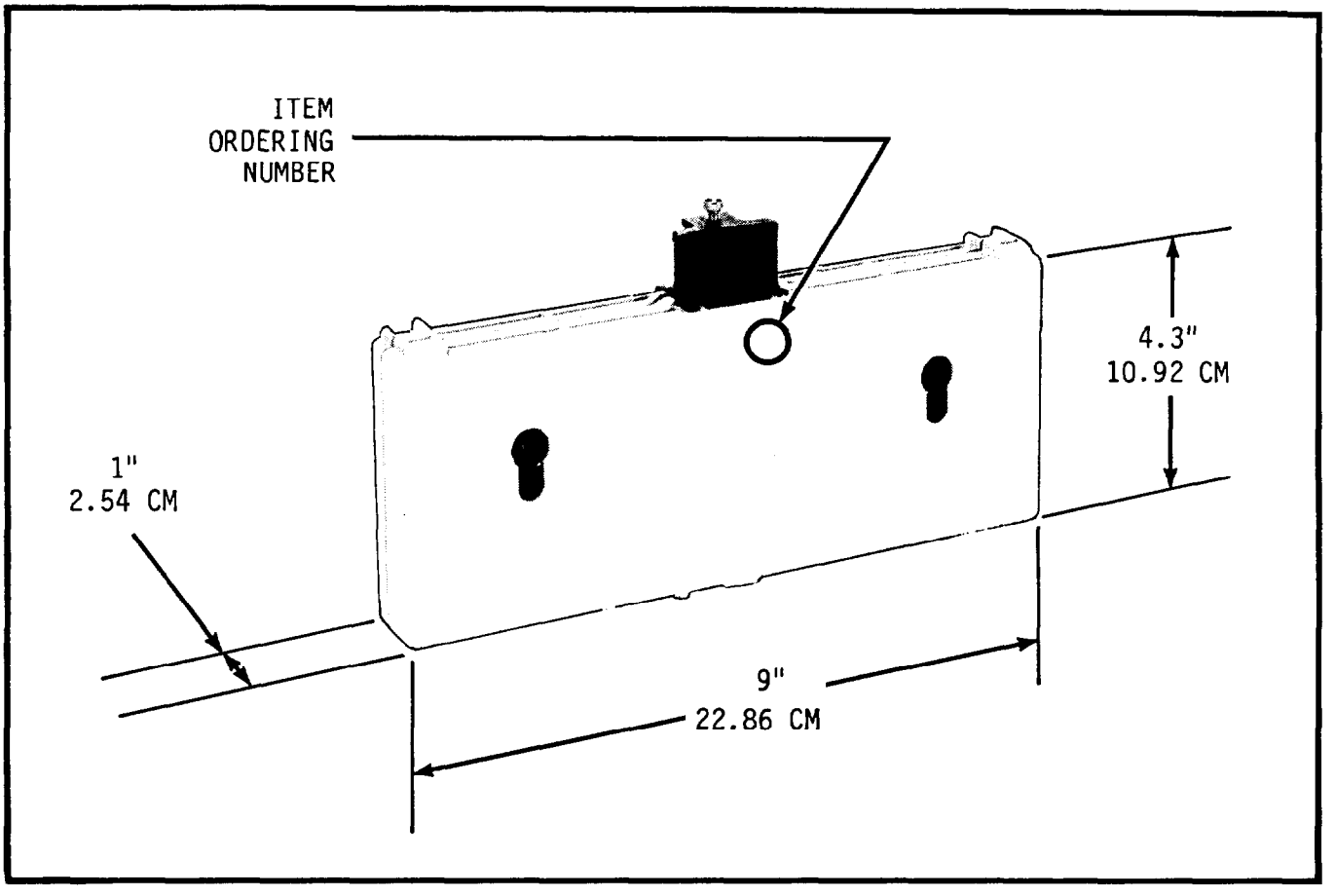



**Figure 1 M-164-71 Converter**

**A. Tone Receiver**

3.05 The tone receiver section of the 164-71 is bridged across the Tip and Ring IN pair at all times as shown in Figure 4. The input impedance of the tone receiver is above 75K ohms at all the frequencies of interest and causes no more than 0.052 dB of loss from the line. This input is filtered to separate the high group and low group DTMF frequencies which are then analyzed for possible detection as a DTMF digit.

**B. Time-Out Release**

3.06 The 16-second Time-Out Release function limits how long the M-164-71 will respond to incoming digits.

3.07 After the Time-Out function has inhibited the M-164-71, it will not respond to signals on the line. This permits end-to-end DTMF signaling. When the unit is inhibited the calling party must go on-hook and back off-hook before the M-164-71 will be enabled again.

3.08 The timer starts when the first DTMF digit is received. This prevents Time-Out from occurring while dial tone is present. The timer is always reset to zero by each succeeding digit recognized and upon on-hook.

**C. Dial Pulse Release**

3.09 The Dial Pulse Release feature first inhibits the converter when a rotary dial pulse is detected. This prevents the converter from remaining enabled during rotary dial calls. (The Time-Out feature does not operate for rotary dial calls.) If the first digit received is a DTMF digit, the Dial Pulse Release is disabled.

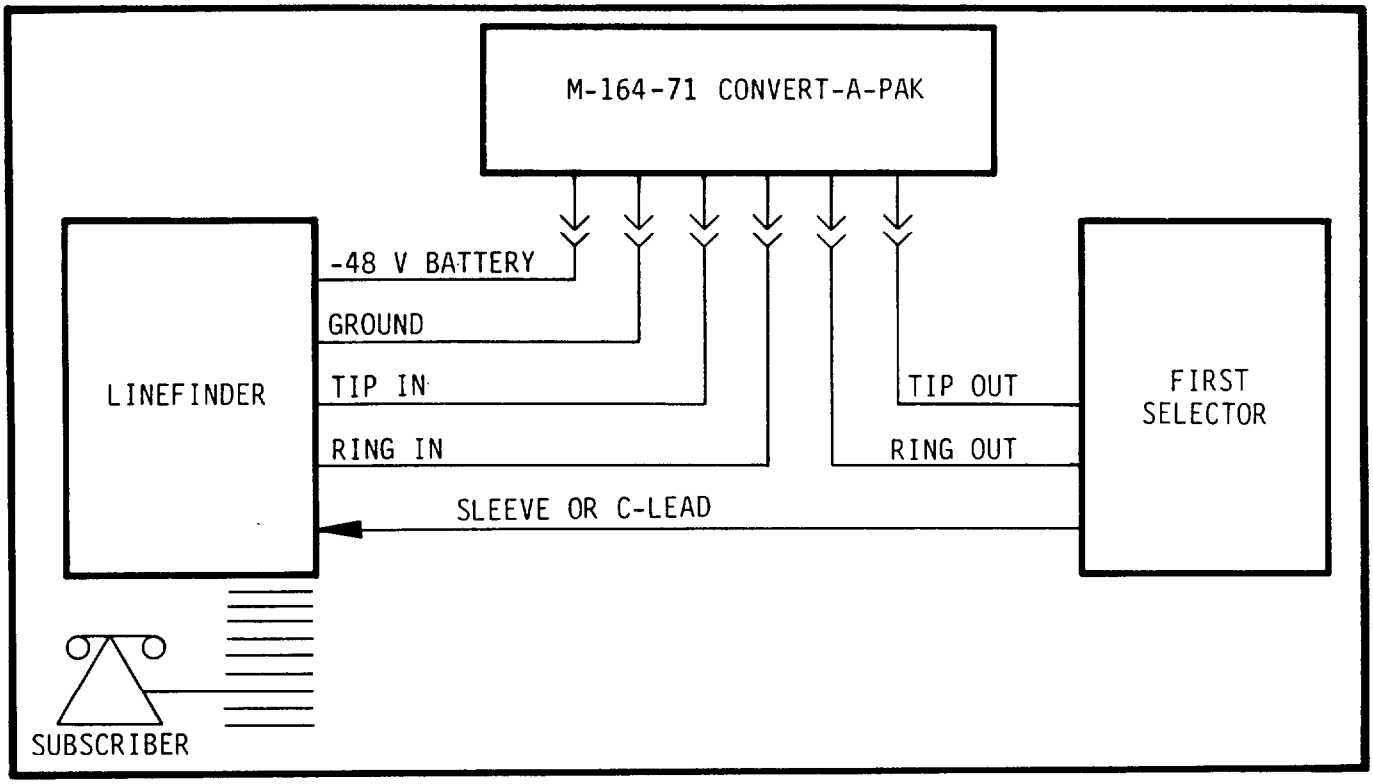
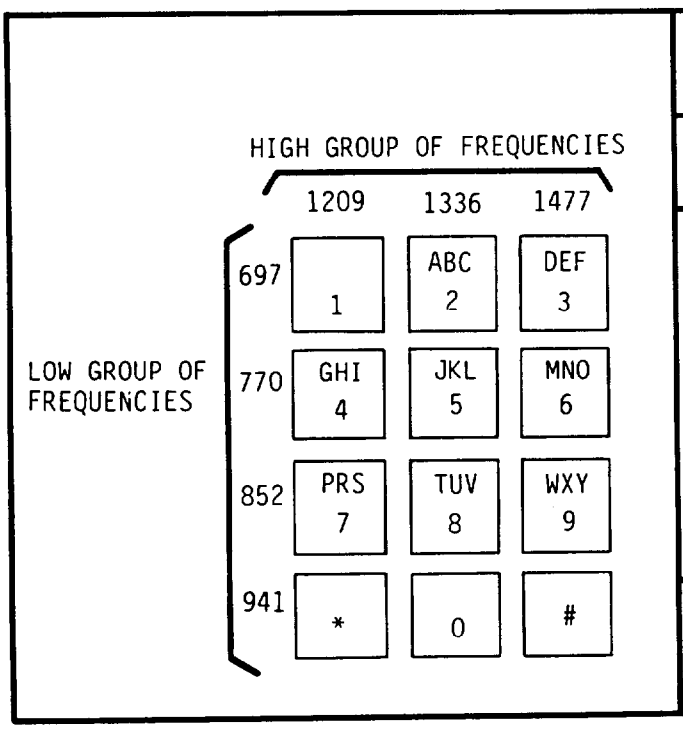



**Figure 2 System Connections**




| DTMF CODE | | |
|---|---|---|
| DIGIT | LOW FREQUENCY | HIGH FREQUENCY |
| 1 | 697 Hz | 1209 Hz |
| 2 | 697 Hz | 1336 Hz |
| 3 | 697 Hz | 1477 Hz |
| 4 | 770 Hz | 1209 Hz |
| 5 | 770 Hz | 1336 Hz |
| 6 | 770 Hz | 1477 Hz |
| 7 | 852 Hz | 1209 Hz |
| 8 | 852 Hz | 1336 Hz |
| 9 | 852 Hz | 1477 Hz |
| 0 | 941 Hz | 1336 Hz |
| * | 941 Hz | 1209 Hz |
| # | 941 Hz | 1477 Hz |

**NOTE:** THE CONVERT-A-PAK RESPONDS TO * OR # ONLY FOR THE END OF DIALING FEATURE.

**Figure 3 DTMF Digit Buttons and Code**

### D. Line Split Function

3.10 For the M-164-71 to generate pulses that will drive the forward switching equipment (complete breaks and makes of loop current on Tip and Ring OUT), the line must be split. Relays in the unit isolate the Tip and Ring IN and OUT pairs. The Tip and Ring IN pair is connected to an internal battery feed source so the subscriber's telephone and the equipment in between still have loop current. During line split Tip and Ring OUT to the first selector are connected in series with the pulsing circuit. A further necessity for splitting the line is to prevent the digit being outpulsed from interfering with succeeding DTMF digits.

3.11 The detection of succeeding DTMF digits holds the line split until they have all been outpulsed. The line is restored after the most recently received digit has been outpulsed.

### E. Answer Supervision Release

3.12 Detection of a polarity reversal on the Tip and Ring pair inhibits the M-164-71. This prevents the unit from outpulsing after the called party goes off-hook. The M-164-71 will stop pulsing and restore the line even if the line is still split because the calling party has inadvertently signaled extra digits.

### F. End of Dialing Feature

3.13 The End of Dialing feature is used when the M-164-71 must be disabled to allow use of DTMF tones for end-to-end signaling. Any digits keyed after a DTMF * or # signal are not recognized or outpulsed.

### G. Dial Pulse Feedback

3.14 An attenuated indication of the outgoing pulses on Tip and Ring OUT is capacitively coupled back via Tip and Ring to the calling station. This provides the subscriber with an indication that the call is being processed.

### H. ANI Forwarding

3.15 The Tip Party Identification (ANI) circuit detects and forwards an impedance imbalance across the Tip and Ring pair while the line is split if the Tip party of a two-party line is the one off-hook. Without this circuit in the M-164-71, the indication is not seen by the forward equipment while the line is split. The operation of this feature is compatible with most toll systems, including A.E. SATT equipment, most pay-station coin ground indications, and most electronic ANI mark systems, for example the Lorain 302 (other ANI mark systems which do not apply the ground mark until requested by the central office may not be compatible with the M-164-71).

## 4. ORDERING INFORMATION

4.01 One M-164-71 will be needed for each linefinder or selector to be converted. Each item ordering number in Table 1 designates one unit as described. Each unit includes a 24-inch connecting cable, two splicing connectors, and the standard mounting hardware (available separately as M-164-25).

4.02 The standard mounting hardware provided with each M-164-71 includes: the standard screw clamp bracket, one 8-32 x 3/4 slotted hex-head machine screw (part number 731-00032-12), and two pan-head 4-20 x 1/4 thread-forming screws (part number 731-00044-04) that secure the bracket to the housing.

4.03 The standard six-wire 24-inch connecting cable can be ordered separately as CA-164-05. A longer 48-inch six-wire cable is available as CA-164-06. A twelve-foot six-wire cable is available as CA-164-12. All the cable leads are color coded and made up of 22-gauge wire. The insulation on each conductor is stripped back 1-5/8 inches from the end. The outside tube of each cable is cut back 4-5/8 inches from the end. Two splicing connectors are supplied with each cable.

Table 1 Item Ordering Numbers

| ITEM ORDERING NUMBERS | DESCRIPTION |
|---|---|
| M-164-71 | Converter Unit (includes 24-Inch Cable and Mounting Bracket) |
| CA-164-05 * | Six-Wire 24-Inch Cable |
| CA-164-06 * | Six-Wire 48-Inch Cable |
| CA-164-12 * | Six-Wire 12-Foot Cable |
| M-164-22 * | Loop-Thru Plug |
| M-164-25 | Standard 5/8-inch opening Mounting Bracket, one 8-32 x 3/4 slotted hex-head machine screw, and two slotted pan-head 4-20 x 1/4 thread forming screws. |
| *** All cables are shipped with two splicing Connectors | |

4.04 The Loop-thru plug, ordered as M-164-22, is available to maintain continuity between the Tip and Ring pairs when the cable is not plugged into an M-164-71. Some installations which prewire the cables install these plugs on the cable connector to retain rotary dial service until the units are installed.

4.05 To assure the specified performance of the M-164-71, dial tone on the lines being converted should be 350 Hz plus 440 Hz Precise Dial Tone. Installation of a TELTONE M-904 Precise Dial Tone Generator is recommended as a means of obtaining such a dial tone. Paragraph 6.04 of this practice explains the dial tone requirements in more detail.

## 5. FUNCTIONAL DESCRIPTION

5.01 To assist maintenance and trouble-shooting this description follows a call as it is handled by the M-164-71 (see Figures 4 and 5).

### A. Idle Condition

5.02 In the idle condition, before the calling station goes off-hook, the unit is disabled and power is removed from the Signal Conditioning and Input Filter stages. This reduces the idle power consumption of the unit to less than 3 watts. No relays are operated.

### B. Enable Converter

5.03 When the calling station goes off-hook and is connected to a line wired through an M-164-71, the Loop Current Detector on Ring IN forwards an indication to the On-Hook/Off-Hook Logic. The converter is enabled to receive DTMF digits when the off-hook indication has persisted for 130 ms (milliseconds).

5.04 (See Figure 5.) Once enabled the M-164-71 remains enabled until on-hook unless it is inhibited by the End of Dialing Release, the Time-Out Release, the Dial Pulse Release or the Answer Supervision Release. Once inhibited, the unit can be enabled again only after recognizing an on-hook condition.

5.05 At this stage the battery feed voltage is being supplied by the forward equipment (usually a first selector) connected to Tip and Ring OUT of the M-164-71. Dial tone is also connected from the forward equipment. Dial tone to the calling station is cut off when the M-164-71 splits the line as described in the following paragraphs. Pulses generated by the converter will then break dial tone in the selector.

### C. Dial Pulse Release

5.06 Any loop current break that occurs 2 to 3 seconds after off-hook is recognized and which persists for 30 ms or more, inhibits tone conversion. This feature is disabled if a DTMF digit is detected first.

### D. DTMF Digit Conversion

5.07 The signals on Tip and Ring IN from the calling station are analyzed to verify that they represent a valid DTMF digit. There must be one and only one DTMF frequency in each group and they must persist for at least 40 ms (the specified guard period).

### E. Line Split

5.08 When the tones have persisted for 40 ms the value of the digit is latched. When the incoming tones end, the line is split in preparation for outpulsing by the operation of the relays shown in Figure 4. This cuts off dial tone to the calling station, connects the internal battery feed supply to the calling station, and connects the ANI forwarding feature to the line. Pulses generated by the converter will pulse the selector.

### F. Memory Function

5.09 As each digit is accepted it is written into a 16-digit memory register and then read out in first-in-first-out order to be outpulsed. This memory is required because valid DTMF digits can be received much faster than they can be outpulsed with the proper interdigital times. The memory function is recirculating so that any number of digits can be received and outpulsed provided the backlog of received-but-not-yet-outpulsed digits never exceeds 16.

### G. Time-Out Function

5.10 The Time-Out function is implemented by a 16-second timer which inhibits the converter at the end of its cycle. This function assures that the converter does not remain enabled after dialing is completed in applications where answer supervision is not present.

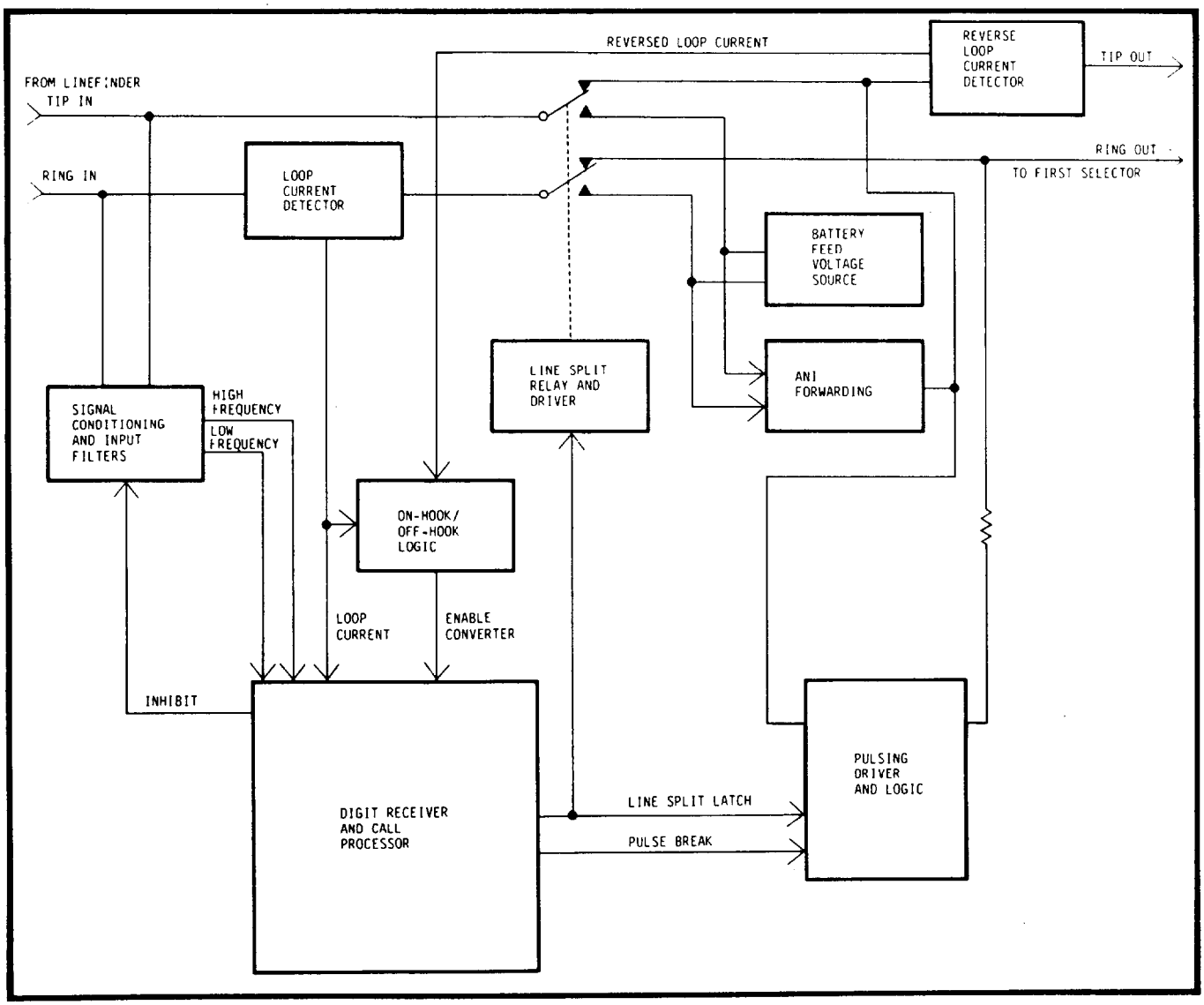



**Figure 4 Simplified Block Diagram**

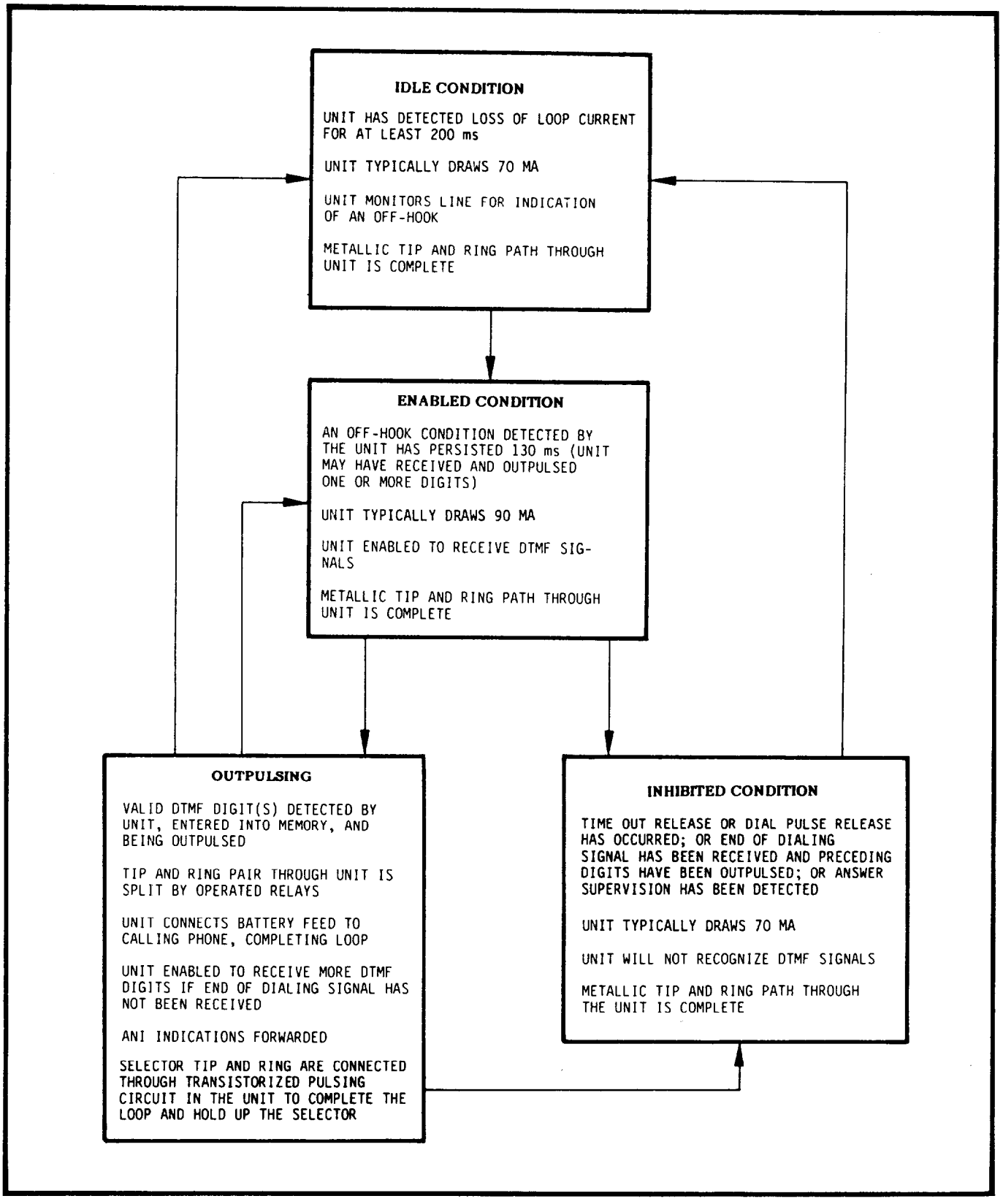



**Figure 5 State Diagram**

5.11 The timer does not start until the first DTMF digit has been validated by the unit. This assures that the unit is not inhibited while dial tone is still present.

5.12 The Time-Out timer is restarted at zero by each succeeding digit. All the DTMF digits received before the timer completes its cycle will be outpulsed.

**H. Outpulsing**

5.13 Converted DTMF digits appear on Tip and Ring OUT as rotary-type dial pulses generated by the transistorized pulsing circuit under the control and timing of the Digit Receiver and Call Processor (see Figure 4). The line is held split during the interdigital times and is restored 670-760 ms after the last pulse of the most recently received digit. If another digit is then received, its outpulsing will not start until one make period after the interdigital time of the previous digit is completed.

**I. End of Dialing Operation**

5.14 The End of Dialing feature is implemented when the unit recognizes either an * or a # DTMF signal. The digit receiver is immediately inhibited from recognizing any succeeding digits. The previously received digits are outpulsed. This feature allows end-to-end DTMF signaling in the absence of answer supervision.

**J. On-Hook/Off-Hook Logic**

5.15 The On-Hook/Off-Hook Logic circuits determine the conditions under which the converter will be enabled at the start of the call and that certain conditions on the line will return the converter to the idle condition. When answer supervision is not present, loss of forward loop current for over 200 ms at Ring IN is considered an on-hook. This implements the on-hook inhibit feature, which is required if the calling subscriber misdials and goes on-hook before outpulsing is completed.

**K. Answer Supervision Release**

5.16 The Answer Supervision Release function disables the converter for the majority of calls by detecting 100 ms of reversed loop current on the Tip and Ring pair when the called party goes off-hook. The unit recognizes the reversal (whether the line is split or restored) and goes into the inhibited state.

## 6. INSTALLATION PROCEDURES

6.01 Prior to installation of the M-164-71 CONVERT-A-PAK units, the equipment being converted should be fully tested for rotary dial operation. A DTMF telephone which is not polarity guarded will help in testing for polarity reversals.

6.02 Examine all the items received to assure they have not been damaged in transit. Compare the item ordering numbers of the units to those listed on the packing slip and Table 1 of this practice to assure the correct items have been received. The item ordering numbers of the M-164's are permanently stamped on the housing. See Figure 6.

6.03 Using Table 2, Installation Checklist, will assure that all necessary installation steps are completed before the unit is put into service.

**A. Dial Tone Requirements**

6.04 Precise Dial Tone is preferred for M-164-71 installations. CONVERT-A-PAK units may operate successfully with other dial tones which do not include components within the DTMF frequency range above the specified noise tolerance level. The M-164-71 is designed to perform as specified in Part 9 of this practice with -12 dBm (0.195 VRMS) per frequency of Precise Dial Tone: pure tones of 350 Hz plus 440 Hz ±0.5 percent and no more than ±3 dB of amplitude variation. (The dBm reading is obtained using a standard voltmeter calibrated to provide a scaled voltage measurement in dBm for a 600 ohm impedance. No termination should be applied for this measurement.)

**Table 2 Installation Checklist**

| | | |
|---|---|---|
| 1. | Recommended Precise Dial Tone supplied to selector being converted. | ☐ |
| 2. | Make linefinder busy and remove its fuse. | ☐ |
| 3. | Remove and identify the Tip and Ring leads going to the first selector from the linefinder jack. | ☐ |
| 4. | Splice the ORANGE-WHITE cable lead to the Ring lead from the first selector. | ☐ |
| 5. | Splice the WHITE-ORANGE cable lead to the Tip lead from the first selector. | ☐ |
| 6. | Connect the BLUE-WHITE cable lead to Ring on the linefinder jack. | ☐ |
| 7. | Connect the WHITE-BLUE cable lead to Tip on the linefinder jack. | ☐ |
| 8. | Connect the WHITE cable lead to -48 volt battery on the linefinder jack. | ☐ |
| 9. | Connect the RED cable lead to office ground on the linefinder jack. | ☐ |
| 10. | Plug the connecting cable into the socket on the bottom of the M-164-71. | ☐ |
| 11. | Perform the installation tests in Part 7 of this practice. | ☐ |
| 12. | Unbusy the linefinder to put the M-164-71 into service. | ☐ |

6.05 The surest procedure is to install a Precise Dial Tone supply like a TELTONE M-904 Precise Dial Tone Generator before installing the M-164-71's. If Precise Dial Tone is not available the M-164-71's should be thoroughly tested to assure their adequate performance.

**B. Wire the Connecting Cable**

6.06 This step constitutes the cutover of the line to DTMF service. Scheduling this step during a period of low traffic is recommended. Assure that the linefinder has been made busy and its fuse removed before beginning the wiring.

6.07 At many installations there are several linefinders associated with each fuse. Before removing such a fuse, busy out all the linefinders associated with it. Then do the wiring for all those linefinders, plug the connecting cables in the M-164-71's, and mount the units. Then replace the fuse.

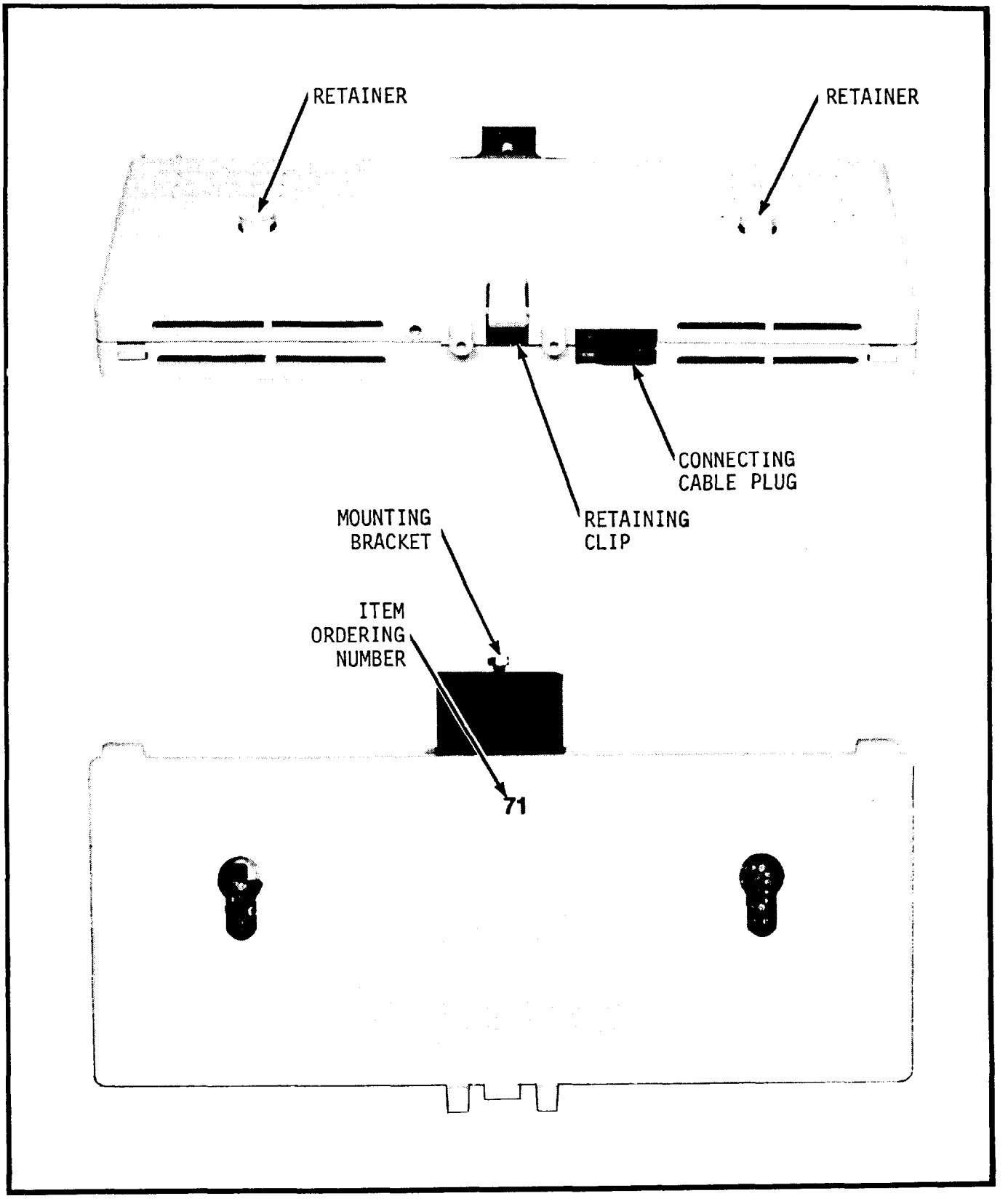



**Figure 6 Views of M-164-71**

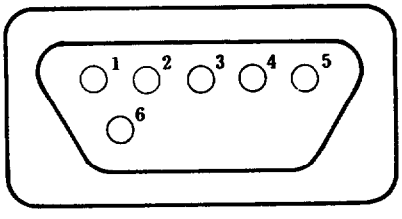
6.08 The usual procedure when wiring several linefinders at once is to then leave each linefinder busied out until the installation of each associated M-164-71 has been tested. It may not be desirable to leave a quantity of linefinders busied out that long. In that case, test all the newly wired linefinders for proper rotary dial operation by completing a rotary dialed call through each one and place those that pass the test back into service. The same procedure applies when Loop-thru plugs are used. Then return to each linefinder to fully test the installation of each M-164-71 as described in Paragraphs 7.05 through 7.12.

6.09 Locate the Tip and Ring connections going to the first selector from the linefinder jack behind the linefinder. Then locate the battery and ground terminals which will be used to supply power to the M-164-71.

6.10 Remove and identify the Tip and Ring leads from the linefinder jack. Reversal of polarity between Tip and Ring will prevent proper operation of the M-164-71.

**Table 3 Connecting Cable Wiring**

| PIN | WIRE COLORS | FUNCTION | CONNECTION |
|---|---|---|---|
| 1 | ORANGE-WHITE | RING OUT | TO FIRST SELECTOR |
| 2 | WHITE-ORANGE | TIP OUT | |
| 3 | BLUE-WHITE | RING IN | FROM LINEFINDER |
| 4 | WHITE-BLUE | TIP IN | |
| 5 | WHITE | BATTERY | LINEFINDER TERMINAL BLOCK |
| 6 | RED | GROUND | |




CABLE CONNECTOR SOCKET DESIGNATIONS

6.11 Splice the Ring lead to the orange wire with the white stripe in the connecting cable. Splice the Tip lead to the white wire with the orange stripe. See Table 3.

6.12 Connect the blue wire with the white stripe in the connecting cable to the Ring terminal of the linefinder jack. Connect the white wire with the blue stripe to the Tip terminal of the linefinder jack.

6.13 The white connecting cable wire must be connected to the -48 volt battery source. Connect the red wire to ground. Then plug the miniature rectangular connector of the cable into the socket on the bottom of the M-164-71. Note that it locks with a definite click. Assure that the first selector does not seize when the connecting cable is plugged in or when the first selector fuse is installed. If there is not an off-hook phone on the line, such a seizure indicates a wiring error (see the troubleshooting part of this practice).

> **Note:** If Loop-thru plugs are being used, the wiring should be tested by completing a rotary-dial call on each line.

6.14 The connecting cable can be wired at the first selector jack if desired. In that case, the orange-white and white-orange cable leads would be connected at the jack terminals while the blue-white and white-blue leads would be spliced to the Tip and Ring leads coming from the linefinder. Refer to Table 3.

### D. Mount the M-164-71

6.15 In the most common application the CONVERT-A-PAK is mounted just above the linefinder cable trough as shown in Figure 7. In practice the units can be hung on almost any horizontal bar within reach of the cable.

6.16 The M-164-71 is just about as long as the width of two linefinder switches. Two M-164-71's are mounted behind each pair of linefinders. The first M-164-71 is secured to the mounting bar by tightening the mounting bracket top with a wrench.

6.17 The second unit is secured by slipping the retainers on the front into the keyslots in the back of the first unit as shown in Figure 8. When the second unit is being secured it will be necessary to press downward until the units are flush at the top and bottom. To separate the units later, the retaining clip at the center of the lower front edge of the second unit must be pulled toward the back as the unit is lifted up out of the keyslots.

6.18 Some linefinder shelves may not have enough clearance below the angle iron to mount the M-164-71's. In these installations the M-164-71's are mounted upside down above the angle iron. Alternatively, the mounting bracket may be moved to the bottom of the housing and the unit mounted right side up (see Figure 9).

6.19 Test the installation as described in Part 7 of this practice before putting the linefinder or selector back into service.

## 7. TESTING THE INSTALLATION

7.01 Normal DTMF and rotary dial traffic through the equipment indicates proper operation of the converter when it is in service. The installation of each converter should be tested, as described in the following paragraphs, before it is put into service. These tests also verify the operation of the converter. Use Table 4 as a checklist to assure that all the tests are completed. Turn to the troubleshooting part of this practice if a converter does not perform as described in each test.

7.02 An M-164-71 does not require maintenance. Routine exercising according to local practices should assure that all the testable functions of each converter are operating.

### A. Test Rotary Dial Operation

7.03 Before installing the linefinder fuse or whatever other power source is being used, go off-hook with a test telephone connected at the linefinder's test jack or an equivalent test point. Dial tone should be heard in the earpiece of the test telephone. There is definitely a fault if the dial tone is not connected. Either dial a rotary digit or flash the hookswitch. If dial tone is not cut off there is a fault.

7.04 Place a rotary dial call. If the call is completed, install the fuse and retest.

### B. Exercise the Conversion Function

7.05 Be sure the fuse(s) applying power to the M-164-71 and the forward equipment are installed. Connect a DTMF test telephone to the linefinder's test jack. Go off-hook with the test phone. Dial tone from the forward equipment will be heard in the test phone. Signal a DTMF numerical digit. The dial tone should be cut off. Do not use the dial pulse feedback, if present, to verify the number of pulses generated. Line splitting and line restoral generate extra clicks. Observe the position to which the forward equipment advances to verify that the number of output pulses matches the digit signaled.

7.06 Verify that the forward equipment (first selector) responds to each of the ten digits. To simplify this observation, go on-hook and back off-hook with the test phone before signaling each digit. Signal the office test number to assure that a complete call can be processed and that the talk path is restored when the called party answers.

### C. Exercise the Time-Out Release

7.07 Go off-hook, wait 20 seconds, and then signal a digit to start the timer. Signal another digit in ten seconds. Verify that both digits are outpulsed. Wait another 20 seconds before signaling a third digit. That digit must not be outpulsed.

### D. Exercise the On-Hook Inhibit

7.08 The M-161-71 must inhibit itself when the calling party goes on-hook. To test this function, go off-hook with the test phone and quickly signal several large digits (say 8's or 9's). Go on-hook with the test phone. Observe that outpulsing stops and the switching train drops before all the digits are outpulsed.

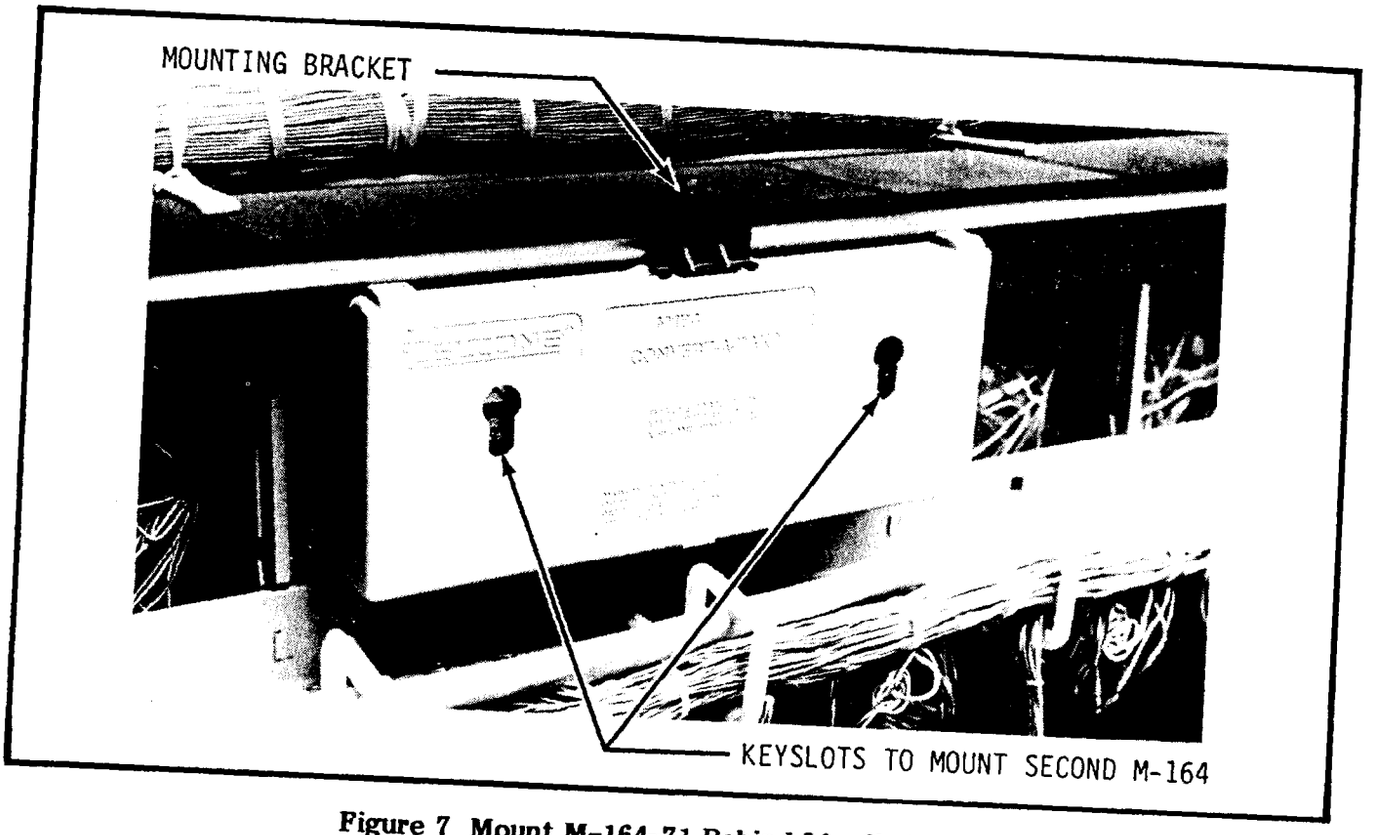



**Figure 7 Mount M-164-71 Behind Linefinders**

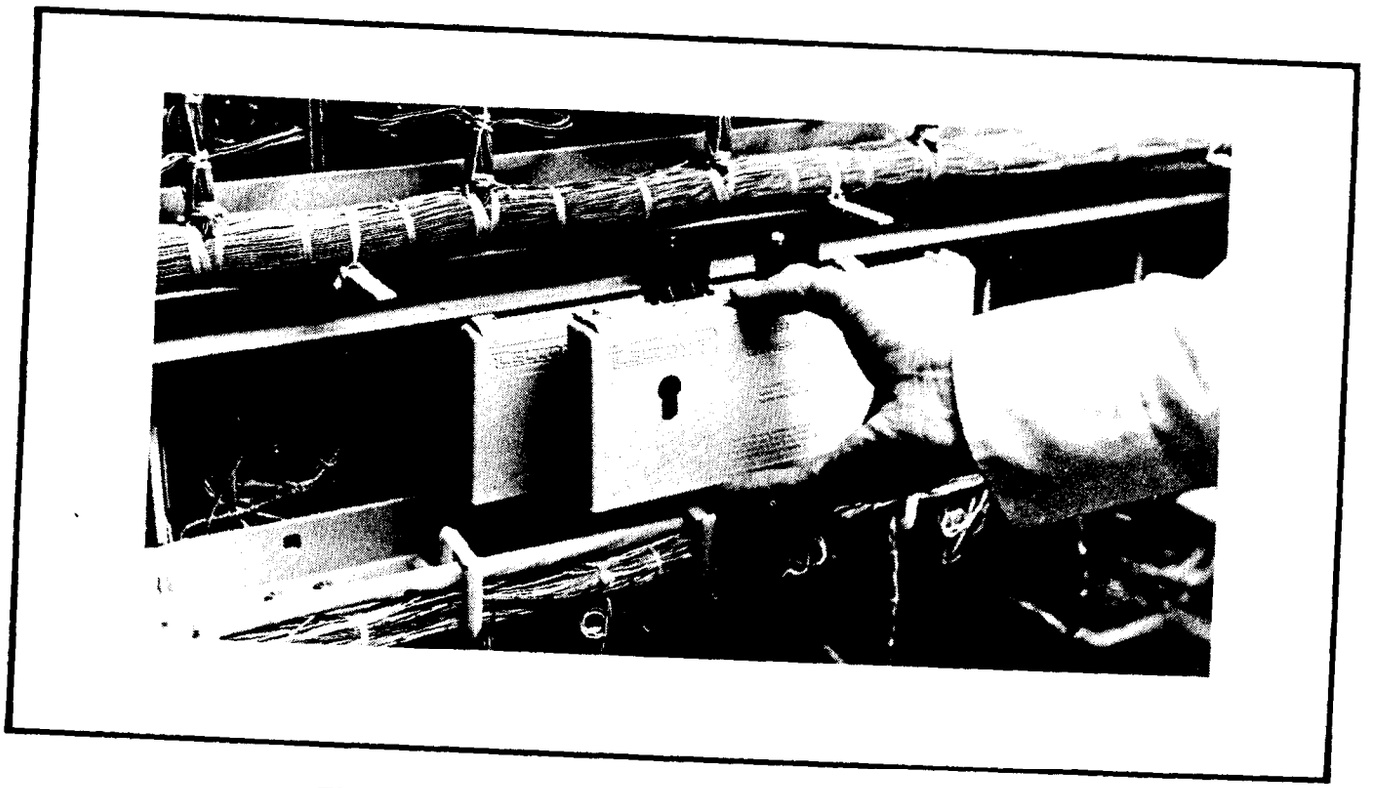


**Figure 8 Second M-164-71 Secures to First Unit**

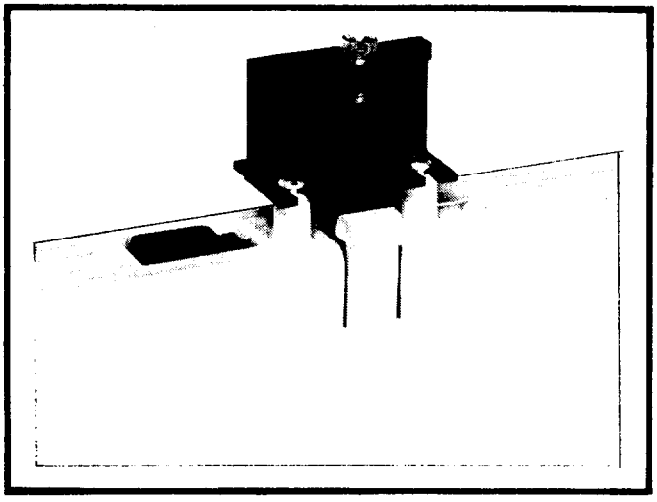


**Figure 9 Remount Screw Clamp on Bottom of Housing**

### E. Exercise the End of Dialing Feature

7.09 Go off-hook with the DTMF test phone and signal any two numerical digits. Follow those digits with a DTMF * character. Signal two more numerical digits. Listen to the dial pulse feedback or watch the forward equipment to verify that only the last two digits are not outpulsed. Go on-hook and back off-hook with the test phone. Repeat the test signaling a DTMF # character after the first two digits.

### F. Exercise the Answer Supervision Release

7.10 Identify a test number or station which is sure to return answer supervision when called. Go off-hook and get dial tone. Signal all but the final digit of the test number. Assure all the digits are outpulsed by listening to the dial pulse feedback. Signal the final digit of the test number and several digit 0's——count them. Listen to the dial pulse feedback to verify that answer supervision inhibits the unit before all the 0's are outpulsed.

> **Note:** The delay before signaling the last digit of the test number is to reset the Time-Out timer and prevent it from interfering with the test. If all the 0's are outpulsed it may mean that the call didn't go through or that the equipment did not return the reversal quickly enough. Repeat the test with about ten 0's to give the office equipment plenty of time to return the reversal.

**Table 4 Installation Test Checklist**

| | | |
|---|---|---|
| 1. | Rotary dial operation is not impaired. | ☐ |
| 2. | DTMF telephone at linefinder's test jack or equivalent test point gets dial tone when off-hook. | ☐ |
| 3. | Going on-hook and off-hook for each one, all ten DTMF numerical digits break dial tone and drive the forward equipment. | ☐ |
| 4. | Called party can be heard in test telephone. | ☐ |
| 5. | Time-Out release exercise completed. | ☐ |
| 6. | On-hook inhibit exercise completed. | ☐ |
| 7. | End of Dialing feature exercise completed. | ☐ |
| 8. | Answer Supervision release exercise completed. | ☐ |
| 9. | ANI Forwarding feature exercise completed. | ☐ |
| 10. | Dial Pulse Release feature exercise completed. | ☐ |
| 11. | M-164-71 put into service. | ☐ |

### G. Exercise the ANI Feature

7.11 Connect an ANI equipped test telephone in parallel with the DTMF test telephone at the linefinder test jack if the DTMF telephone is not ANI equipped. Test for

presence of the ANI indication at the forward equipment as described in the appropriate BSP or local practice while the line is split by the M-164-71. (The M-164-71 holds the line split only while outpulsing and during the interdigital times when one or more digits remain in memory for outpulsing.)

**H. Exercise the Dial Pulse Release Feature**

7.12 Go off-hook. After three seconds, flash the hookswitch several times. Then signal a DTMF numeral digit and observe that it is not outpulsed.

**I. Place the Converter in Service**

7.13 When all the applicable tests have been successfully completed, the M-164-71 can be put into service. Disconnect the test telephone(s) and assure that the linefinder is unbusied.

## 8. TROUBLESHOOTING THE M-164-71

8.01 The unit must be sent to the appropriate service center if these troubleshooting procedures indicate a faulty M-164-71. The M-164-71 has no field serviceable or field replaceable components.

8.02 The most common wiring fault is misplacing the Tip and Ring leads.

8.03 The simplest way to determine whether fault is in the wiring or the converter, is to swap the faulty unit with another one, preferably one that is installed and working properly. Obviously, there is a converter fault if one unit works and another does not in the same installation. The troubleshooting figures are designed to be of assistance where a known good unit is not available, or when it is necessary to determine a wiring error by indirect methods.

8.04 Which figure to use for isolating faults depends on whether the unit has been in service and operating properlv prior to the failure or is an initial installation. If the unit has been in service and operating, use Figure 10. If the problem is with an initial installation, use Figure 11 or 13, depending on whether the fault occurs before or only after the power fuse is installed.

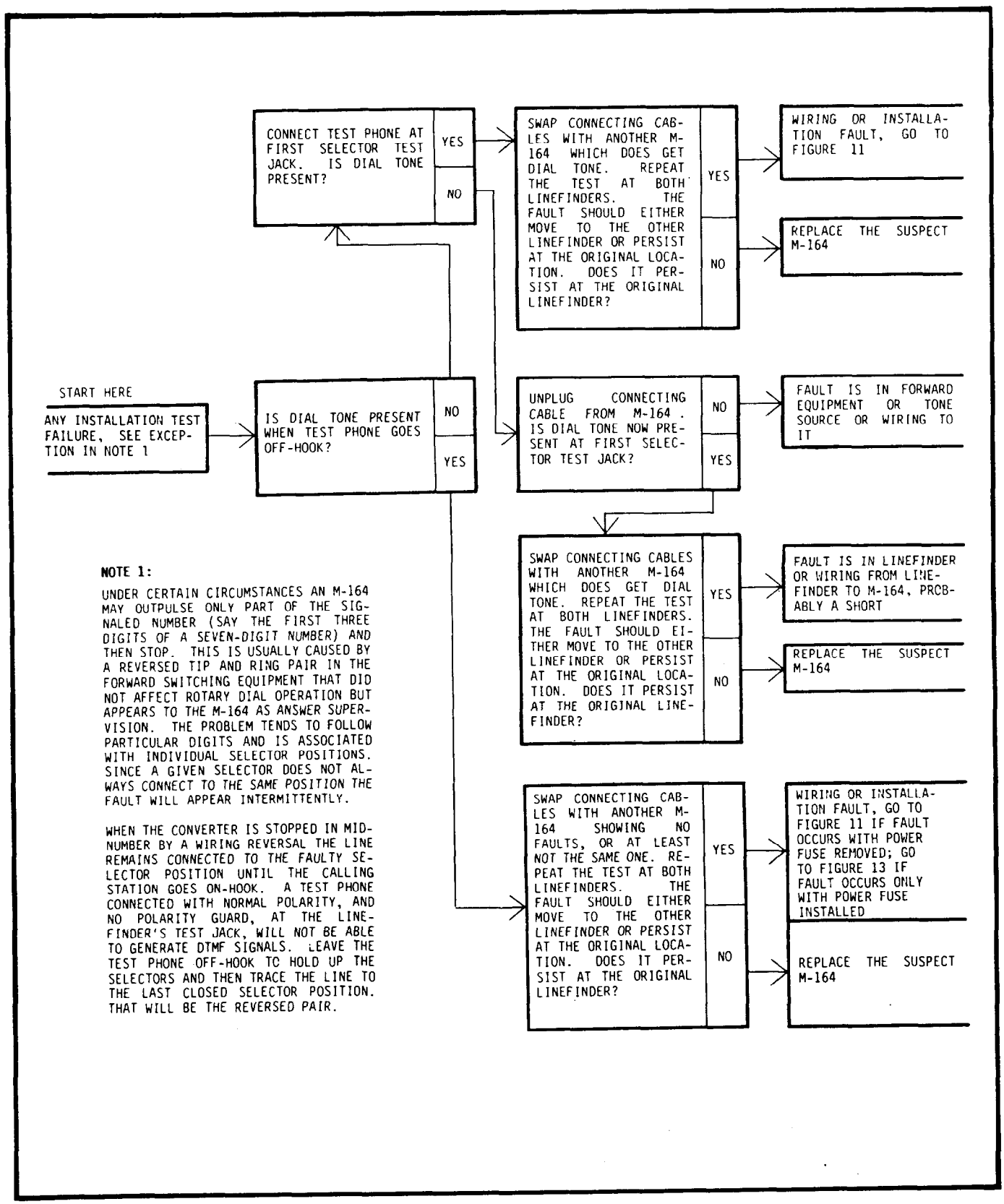



**Figure 10 Troubleshooting Procedure**

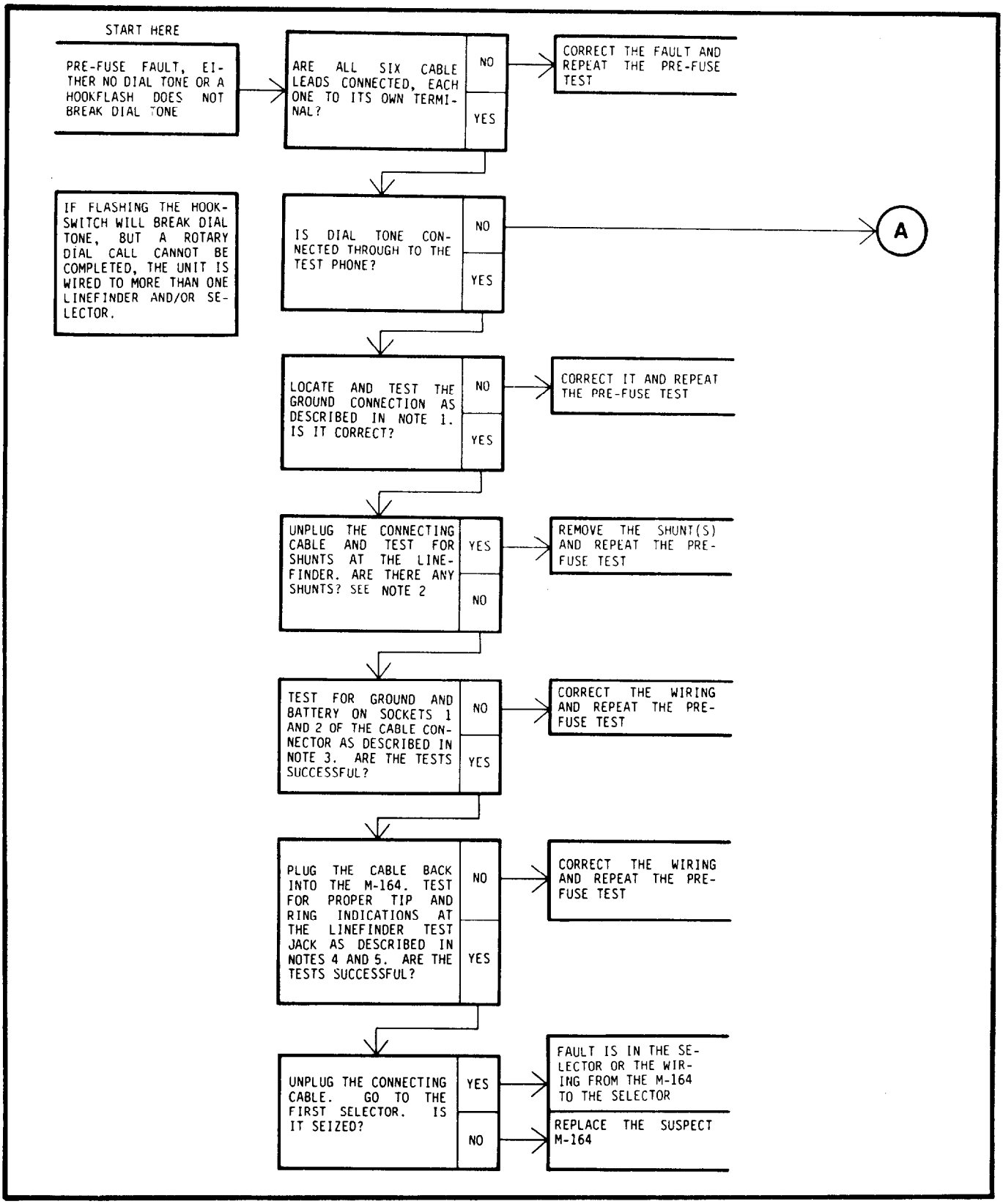
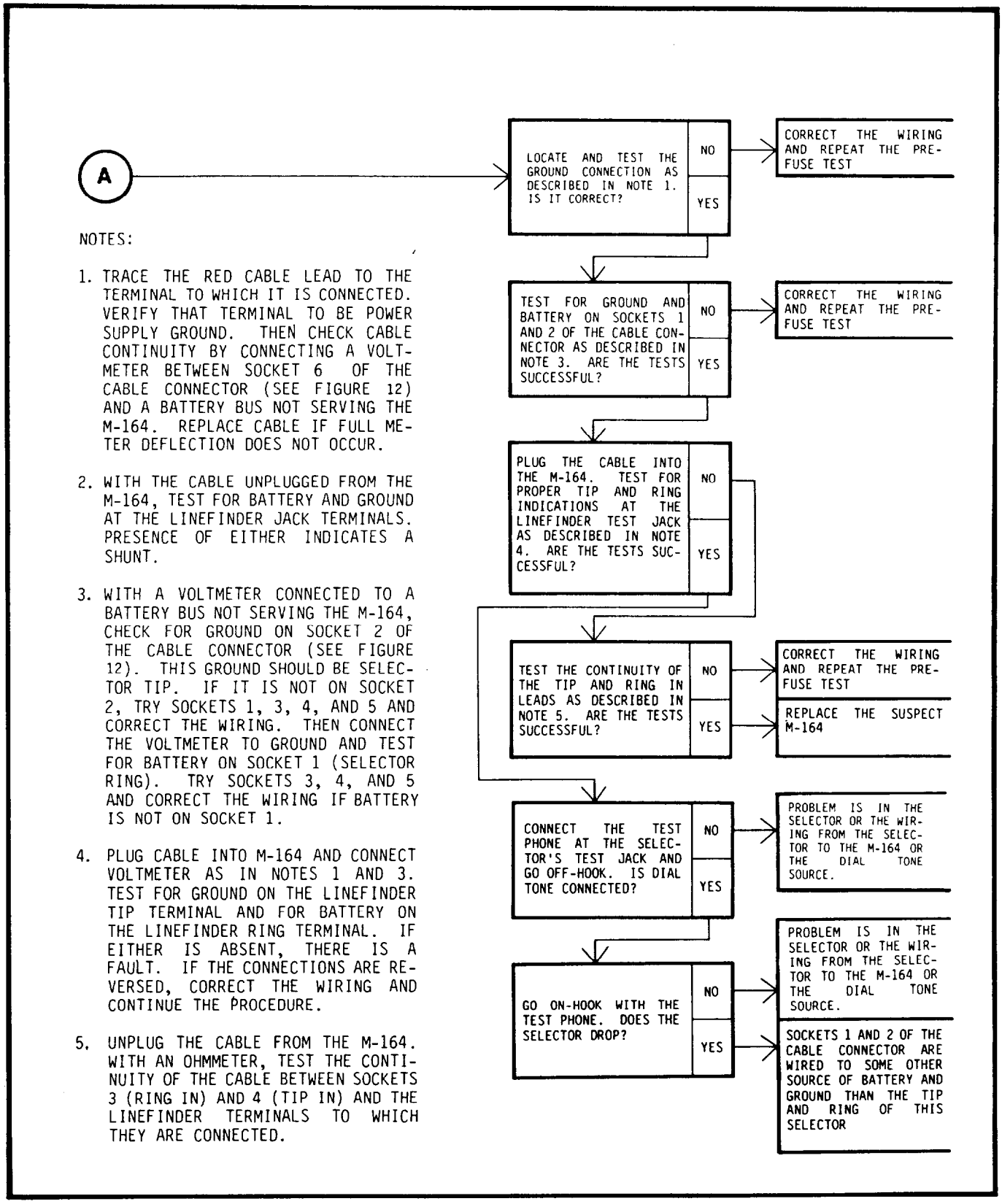



**Figure 11 Pre-Fuse Fault Isolation (Sheet 1 of 2)**




NOTES:

1. TRACE THE RED CABLE LEAD TO THE TERMINAL TO WHICH IT IS CONNECTED. VERIFY THAT TERMINAL TO BE POWER SUPPLY GROUND. THEN CHECK CABLE CONTINUITY BY CONNECTING A VOLTMETER BETWEEN SOCKET 6 OF THE CABLE CONNECTOR (SEE FIGURE 12) AND A BATTERY BUS NOT SERVING THE M-164. REPLACE CABLE IF FULL METER DEFLECTION DOES NOT OCCUR.

2. WITH THE CABLE UNPLUGGED FROM THE M-164, TEST FOR BATTERY AND GROUND AT THE LINEFINDER JACK TERMINALS. PRESENCE OF EITHER INDICATES A SHUNT.

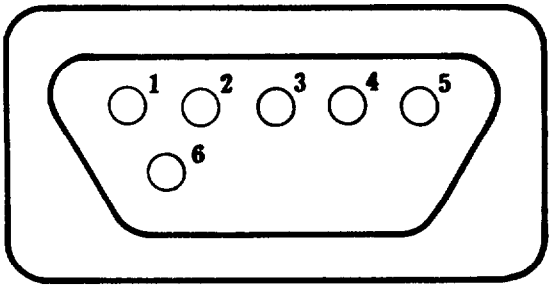
3. WITH A VOLTMETER CONNECTED TO A BATTERY BUS NOT SERVING THE M-164, CHECK FOR GROUND ON SOCKET 2 OF THE CABLE CONNECTOR (SEE FIGURE 12). THIS GROUND SHOULD BE SELECTOR TIP. IF IT IS NOT ON SOCKET 2, TRY SOCKETS 1, 3, 4, AND 5 AND CORRECT THE WIRING. THEN CONNECT THE VOLTMETER TO GROUND AND TEST FOR BATTERY ON SOCKET 1 (SELECTOR RING). TRY SOCKETS 3, 4, AND 5 AND CORRECT THE WIRING IF BATTERY IS NOT ON SOCKET 1.

4. PLUG CABLE INTO M-164 AND CONNECT VOLTMETER AS IN NOTES 1 AND 3. TEST FOR GROUND ON THE LINEFINDER TIP TERMINAL AND FOR BATTERY ON THE LINEFINDER RING TERMINAL. IF EITHER IS ABSENT, THERE IS A FAULT. IF THE CONNECTIONS ARE REVERSED, CORRECT THE WIRING AND CONTINUE THE PROCEDURE.

5. UNPLUG THE CABLE FROM THE M-164. WITH AN OHMMETER, TEST THE CONTINUITY OF THE CABLE BETWEEN SOCKETS 3 (RING IN) AND 4 (TIP IN) AND THE LINEFINDER TERMINALS TO WHICH THEY ARE CONNECTED.

**Figure 11 Pre-Fuse Fault Isolation (Sheet 2 of 2)**

| PIN | WIRE COLORS | FUNCTION | CONNECTION |
|---|---|---|---|
| 1 | ORANGE-WHITE | RING OUT | TO FIRST SELECTOR |
| 2 | WHITE-ORANGE | TIP OUT | |
| 3 | BLUE-WHITE | RING IN | FROM LINEFINDER |
| 4 | WHITE-BLUE | TIP IN | |
| 5 | WHITE | BATTERY | LINEFINDER TERMINAL BLOCK |
| 6 | RED | GROUND | |




CABLE CONNECTOR SOCKET DESIGNATIONS

**Figure 12 Connector Cable Sockets**

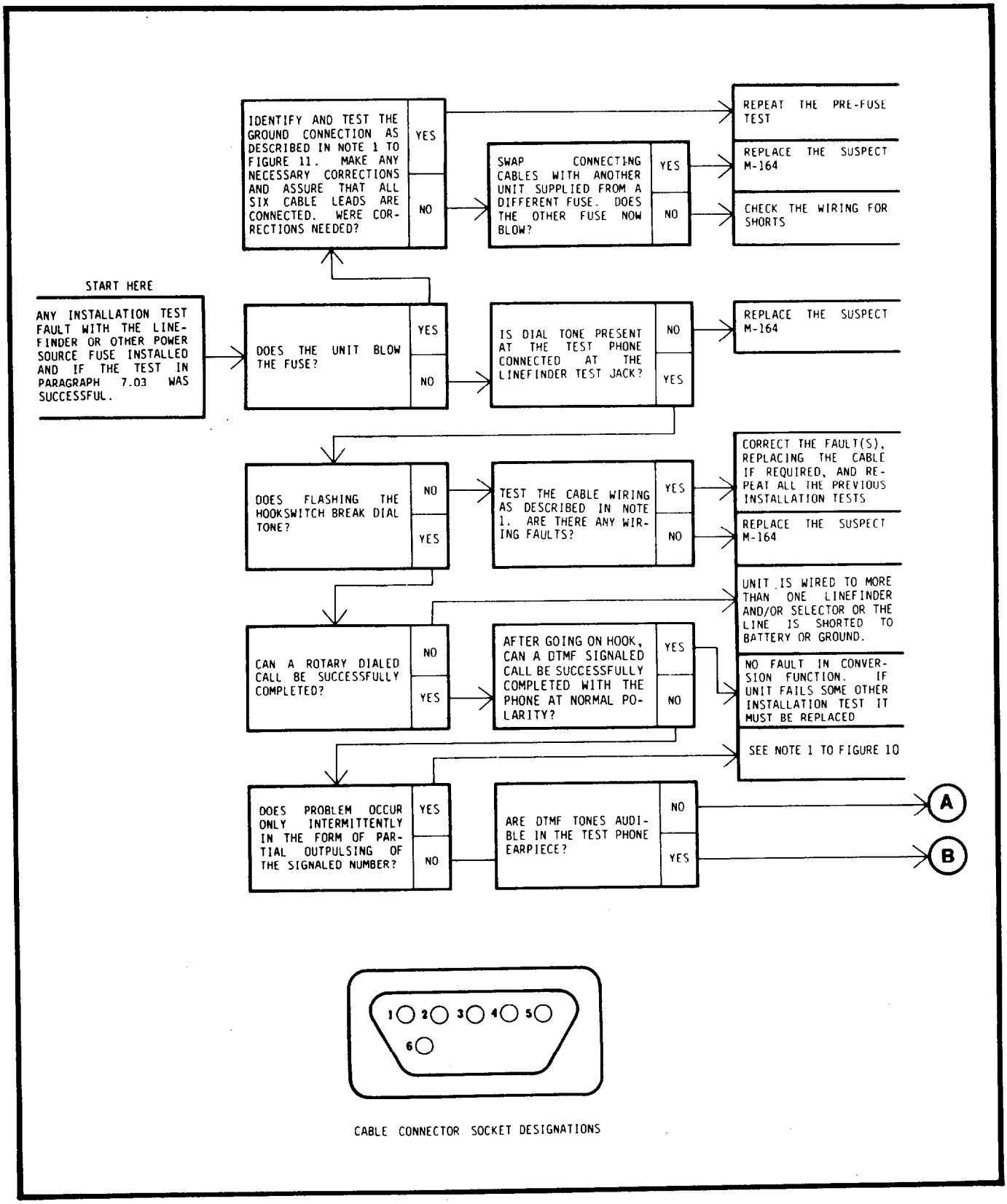



**Figure 13 Installation Test Post-Fuse Faults (Sheet 1 of 4)**

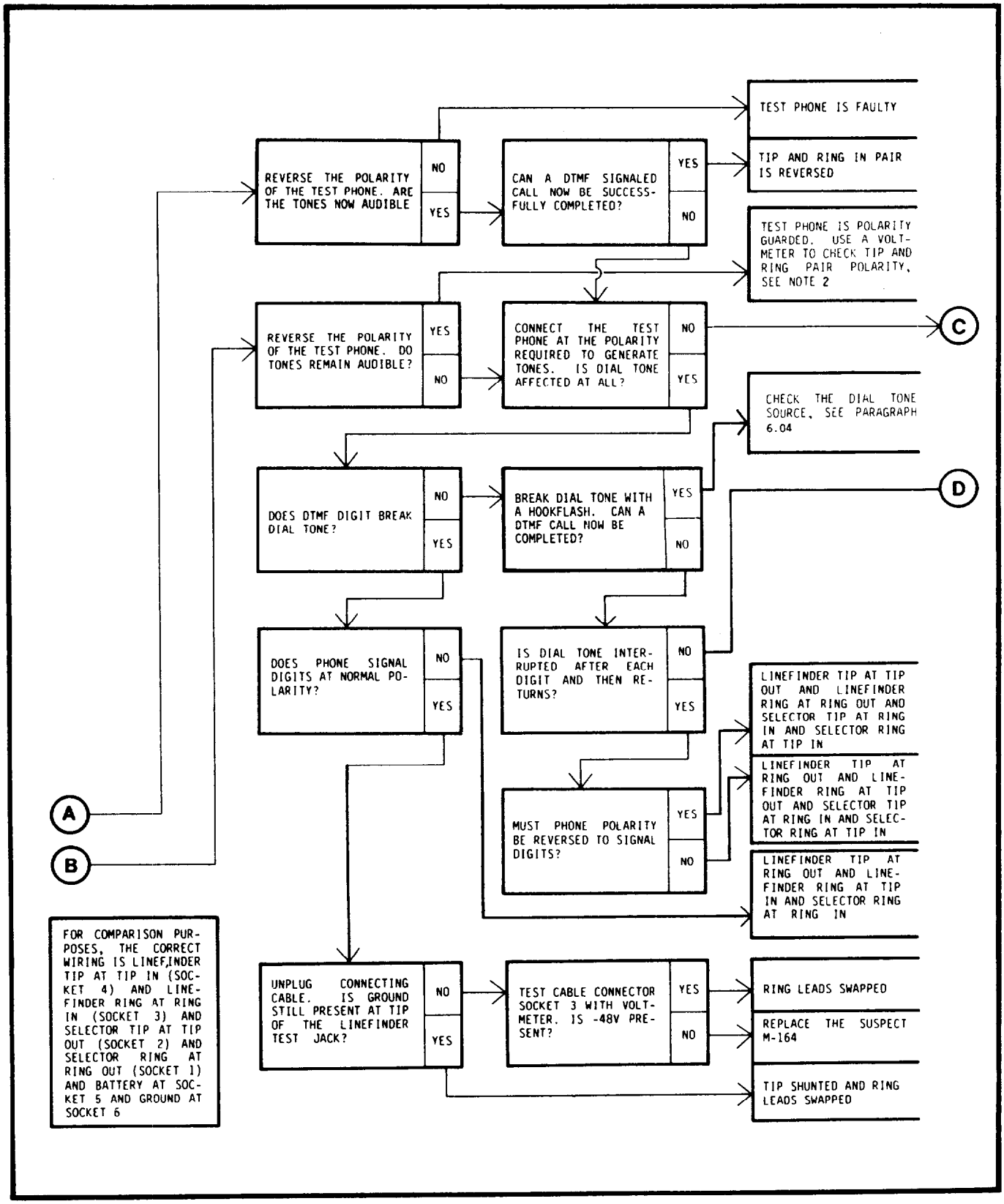



**Figure 13 Installation Test Post-Fuse Faults (Sheet 2 of 4)**

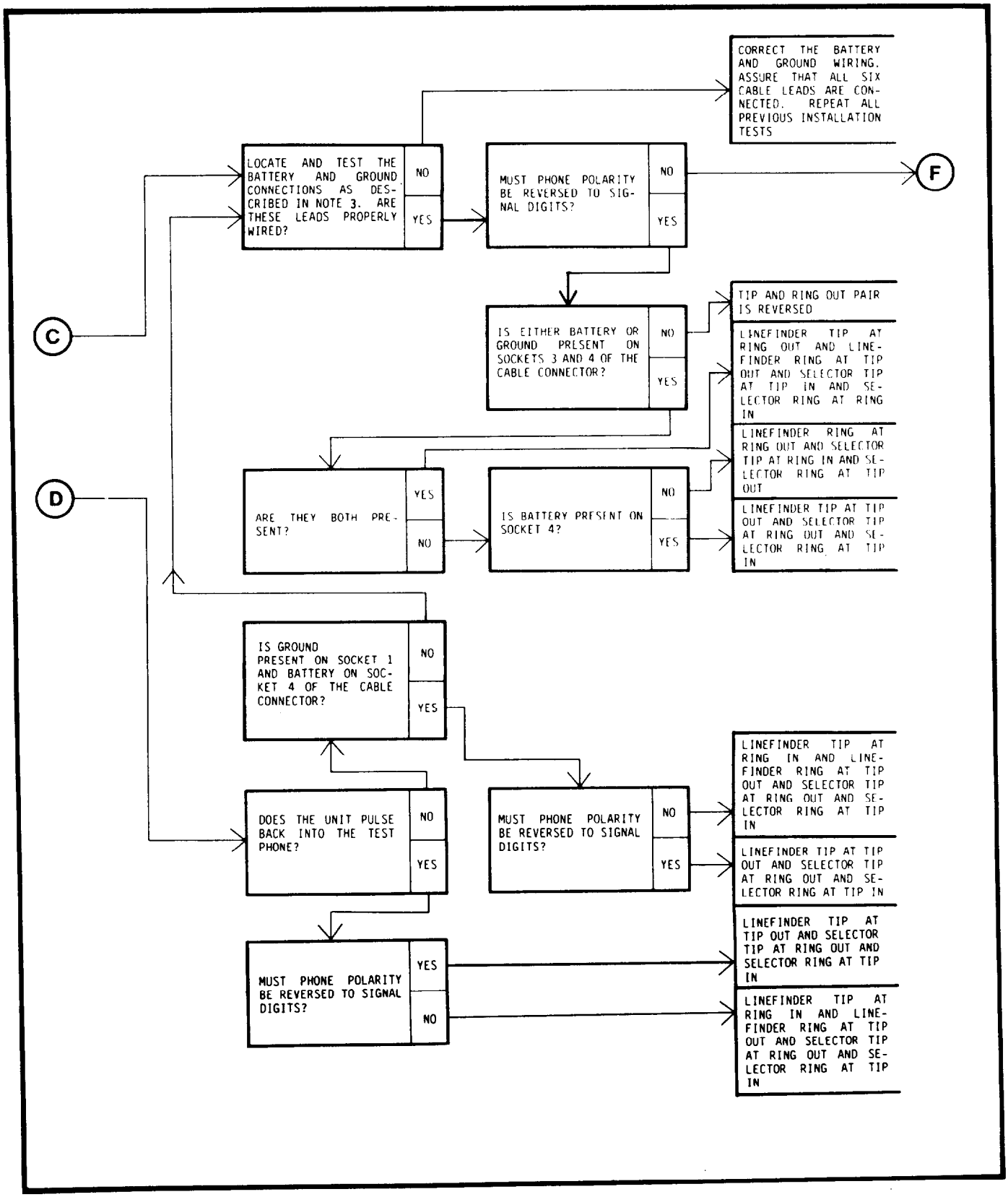
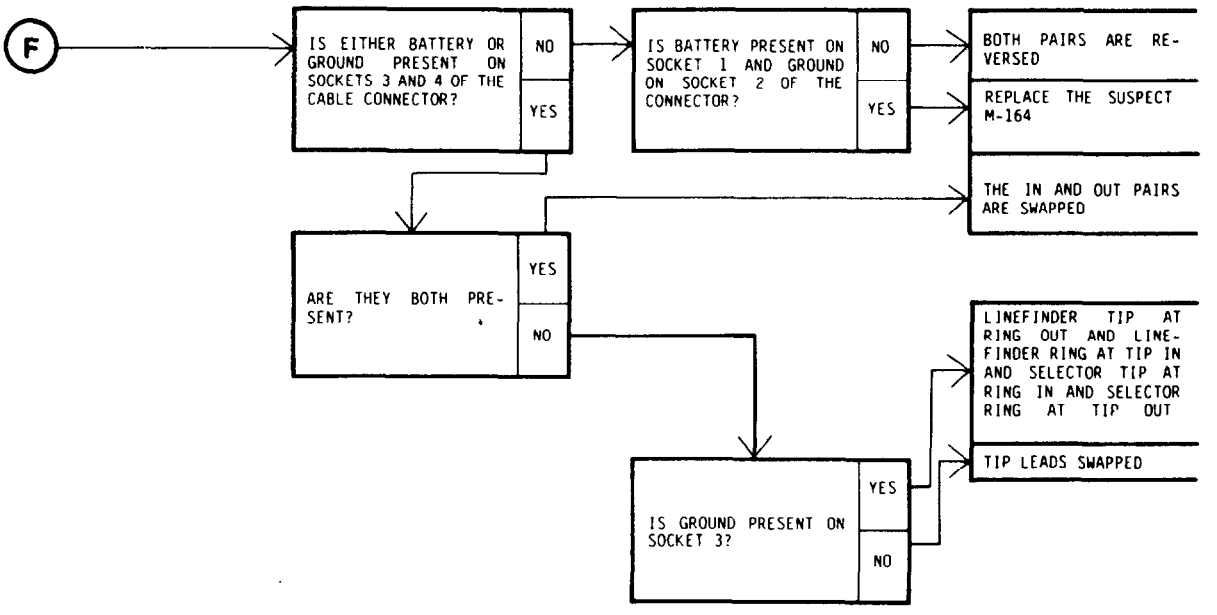



**Figure 13 Installation Test Post-Fuse Faults (Sheet 3 of 4)**




**NOTES:**

1. UNPLUG THE CABLE FROM THE M-164. CONNECT THE POSITIVE SIDE OF A VOLTMETER TO GROUND AND VERIFY THAT BATTERY IS ON SOCKET 5 OF THE CABLE CONNECTOR (SEE FIGURE 12). THEN VERIFY THAT BATTERY IS PRESENT ON SOCKET 1. THEN CONNECT THE NEGATIVE SIDE OF THE VOLTMETER TO A BATTERY BUS NOT SERVING THE M-164 AND VERIFY THAT GROUND IS ON SOCKETS 2 AND 6 AND NOT ON SOCKETS 3 AND 4. FINALLY, TEST THE CONTINUITY OF THE CABLE WITH AN OHMMETER.

2. TO CHECK THE POLARITY OF THE LINEFINDER TEST JACK, LEAVE THE TEST PHONE CONNECTED AND GO OFF-HOOK. CONNECT THE POSITIVE SIDE OF A VOLTMETER TO GROUND. IF THE POLARITY IS CORRECT, THE RING TERMINAL WILL BE MORE NEGATIVE THAN THE TIP TERMINAL. IF IT IS REVERSED THE TIP TERMINAL WILL BE THE MORE NEGATIVE. NOTE WHICH CONDITION EXISTS AND PROCEED WITH THE TROUBLESHOOTING STEPS. WHENEVER THE STEPS ASK ABOUT THE POLARITY AT WHICH THE TEST PHONE WILL SIGNAL DIGITS, ANSWER "NORMAL" OR "REVERSED" AS INDICATED BY THE METER TEST.

3. REMOVE THE SUPPLYING FUSE AND UNPLUG THE CONNECTING CABLE FROM THE M-164. WITH AN OHMMETER VERIFY THAT CONTINUITY IS PRESENT BETWEEN SOCKET 6 OF THE CABLE CONNECTOR AND THE TERMINAL TO WHICH THE RED CABLE LEAD IS CONNECTED. ALSO TEST FOR CONTINUITY BETWEEN SOCKET 5 OF THE CONNECTOR AND THE TERMINAL TO WHICH THE WHITE CABLE LEAD IS CONNECTED. IF EITHER OF THESE CONTINUITIES IS NOT PRESENT, CORRECT THE CABLE WIRING. IF BOTH CONTINUITIES ARE PRESENT, INSTALL THE FUSE AND VERIFY THAT THE WHITE CABLE WIRE IS CONNECTED TO -48 VOLT BATTERY AND THE RED CABLE WIRE IS CONNECTED TO GROUND. IF THE POWER CONNECTIONS APPEAR SATISFACTORY, ASSURE THERE ARE NO SHUNTS IN THE WIRING BY LEAVING THE CABLE DISCONNECTED AND TESTING AT THE LINEFINDER TEST JACK WITH THE METER THAT NEITHER BATTERY OR GROUND ARE PRESENT ON THE TIP OR RING TERMINALS.

**Figure 13 Installation Test Post-Fuse Faults (Sheet 4 of 4)**

## 9. SPECIFICATIONS

| | |
|---|---|
| Input Impedance | |
| (tone receiver) | 75K ohms minimum, AC coupled (see note 1) |
| Input DTMF Signaling | |
| Signal Accept level (per frequency) | -22 to +6 dBm (0.062 to 1.55 VRMS), see note 2 |
| Signal reject level (per frequency) | 0.138 VRMS (-35 dBm) see note 2 |
| Tone accept bandwidth | ±(1.5% +2 Hz) |
| Tone reject bandwidth | ±3.5% |
| Signal accept duration | ≥40 ms |
| Signal reject duration | ≤25 ms |
| Input accept interdigital time | ≥40 ms |
| Input reject interdigital time | ≤25 ms |
| Signal cycle time | ≥85 ms |
| Amplitude difference (twist), high frequency relative to low frequency | +6 dB<br>-8 dB,<br>see note 3 |
| Noise tolerance | -20 dB, see note 4 |
| DTMF digit recognition after off-hook | ≥130 ms |
| Register Capacity | 16 digits, see note 5 |
| Interface Characteristics | |
| Insertion loss | ≤0.1 dB |
| Longitudinal balance | |
| talk-through | ≤60 dB (see note 1) |
| signaling during line split | ≤50 dB (see note 1) |
| Loop current recognition | ≥10 ma |
| ANI offset recognition | ≤2700 ohms |
| ANI offset rejection | ≥5400 ohms |
| ANI offset forwarding | 1500 ±150 ohms |
| Input DC Signaling | |
| Answer supervision recognition | 100 ms (typical) |
| On-hook recognition | 200 ms minimum |
| Blanking for Dial Pulse Release | 2 to 3 seconds from off-hook |
| Dial Pulse Break recognition | 30 ms minimum |
| Output Signaling | |
| Pulse rate | 10 ± 0.5 PPS |
| Pulse ratio | 58% to 62% break |
| Outpulse interdigital time | 670-760 ms |
| Outpulse loop resistance | 300 ohms ±10% |
| Time-Out Period | 16 ±1 seconds |
| Line restoral time after the last break pulse of the most recently received digit | 670-760 ms |
| Power Requirements | |
| Voltage | -43 to -56 VDC |
| Current | |
| idle or inhibited | 70 ma, typical |
| enabled | 90 ma, typical |
| outpulsing | 90 ma, typical (does not include battery feed current to subscriber) |

| | |
|---|---|
| Fusing requirement | 1/3 ampere |
| **Environmental Requirements** | |
| Temperature limits (up to 50% relative humidity and 700 to 800 mm Hg) | 0° to 55° C |
| Relative humidity limits (at 0° to 55° C and 700 to 800 mm Hg for periods up to 72 hours) | 0 to 85% |
| Circuit Board Material (Epoxy impregnated fiberglass) | FR4 per MIL-P-13949, UL approved |

Specifications are subject to change without notice.

Note 1: For frequencies 200 Hz to 3000 Hz, loop current 60 ma minimum.

Note 2: Voltage levels stated in dBm are obtained using a standard voltmeter calibrated to provide a scaled voltage measurement in dBm for a 600 ohm impedance. No termination should be applied for this measurement.

Note 3: Combined level of random, difference, and harmonic noise components at least 40 dB below the lowest level DTMF component.

Note 4: Relative to lowest level DTMF component with DTMF test tones at centerband, twist ±1 dB with combined harmonics and difference frequencies at -32 dB below lowest level DTMF component. Noise level is not to exceed -35 dBm.

Note 5: Digit register is recirculating such that any number of digits may be received and outpulsed as long as the backlog of received but not yet outpulsed digits does not exceed 16 digits.