

TOUCH CALLING UNITS
SHOP PROCEDURES

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1. GENERAL

1.01 This section contains shop procedures for Touch Calling Units (TCU's), Part No. D-84969, D-84971, D-

840000, D-840007, HD-840100, HD-840101, HD-840106, HD-840107, HD-840109, and HD-840120. The shop procedures include the disassembly and reassembly of each basic type of TCU, cleaning of the keysets and contact springs, common switch maintenance, and testing of the tone generators.

1.02 Touch Calling units D-84969 and D-84971 are no longer manufactured; however, because many of these TCU's are still in use, the shop procedures for them are retained in this section.

1.03 This section is reissued to include shop procedures for TCU's HD-840100, HD-840101, HD-840106, HD-840107, HD-840109, and HD-840120. Due to the extensive changes involved, marginal arrows are omitted. Remove the previous issue of this section from the binder or microfiche file and replace it with this issue.

2. DESCRIPTION

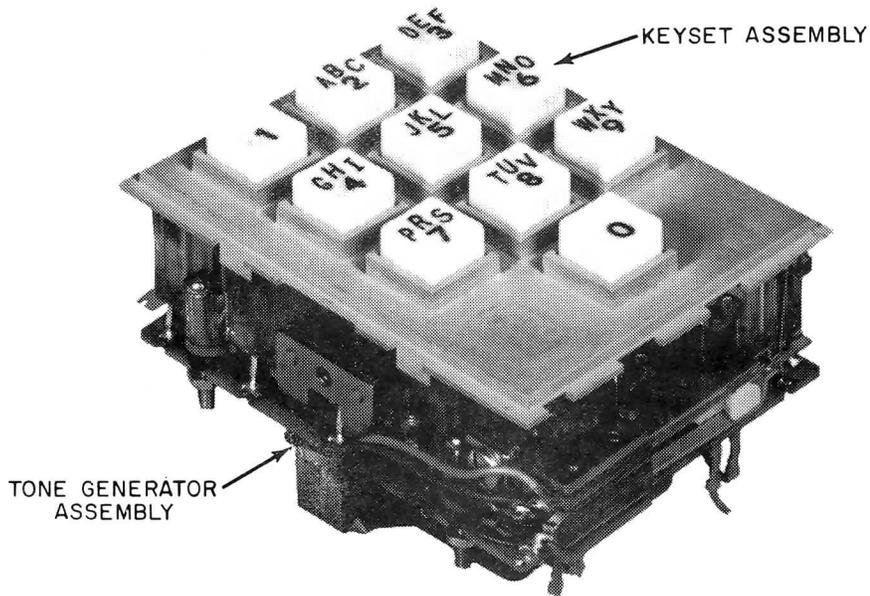
2.01 The two major parts of a TCU (Figures 1 through 3) are a keypad assembly and a tone generator assembly. The keypad assembly selects the two frequencies that represent each digit. The tone generator assembly produces seven frequencies (Table 1) that are used in different combinations to represent 12 different digits.

2.02 The keypad assembly for TCU D-84969 has 10 pushbuttons while the keypad assembly in all other TCU's has 12 pushbuttons. The keypad assemblies in TCU's D-84969 and D-84971 are basically the same in construction and operation and are described together. The other keypad assemblies have certain differences in their operation and construction and are described individually.

Touch Calling Units D-84969 and D-84971

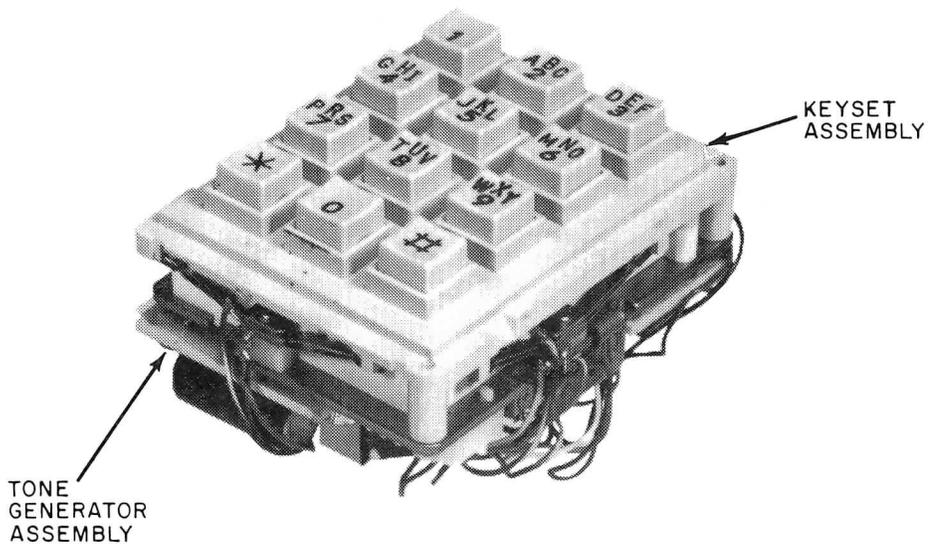
2.03 The keypad consists essentially of either 10 or 12 pushbuttons assembled within a bearing plate with a return spring and two lever springs (make) for each pushbutton (Figures 4, 5, and 6). When a pushbutton is depressed, the two lever springs make with two top conductors and prepare tuned circuits for the two distinct frequencies. One of these circuits generates a frequency in the low group, and the other generates a frequency in the high group (Table 1).

2.04 The two lever springs actuated by each pushbutton are located at the opposite corners of the pushbutton, behind a snap-on subfaceplate and faceplate. The subfaceplate and faceplate, which protect the keypad from dust and damage, may be removed for access to the contact springs. The lever springs do not require adjustment. The springs are entirely enclosed within the plastic bearing plate, out of the way of the telephone wiring.



NOTE:
10-PUSHBUTTON TCU D-84969 IS SHOWN.
TCU D-84971 IS SIMILAR EXCEPT IT CONTAINS
12 PUSHBUTTONS.

Figure 1. Touch Calling Units D-84969 and D-84971.



NOTE:
ALL TCU'S ARE SIMILAR EXCEPT FOR HD-840107
AND HD-840109. TCU HD-840107 HAS A DIFFERENT
CONTACT SPRING ARRANGEMENT AND ATTACHED
MOUNTING BRACKETS. TCU HD-840109 HAS NUMERIC
PUSHBUTTONS ONLY.

Figure 2. Touch Calling Units D-840000, HD-840100, HD-840101,
HD-840106, HD-840107, HD-840109, and HD-840120.

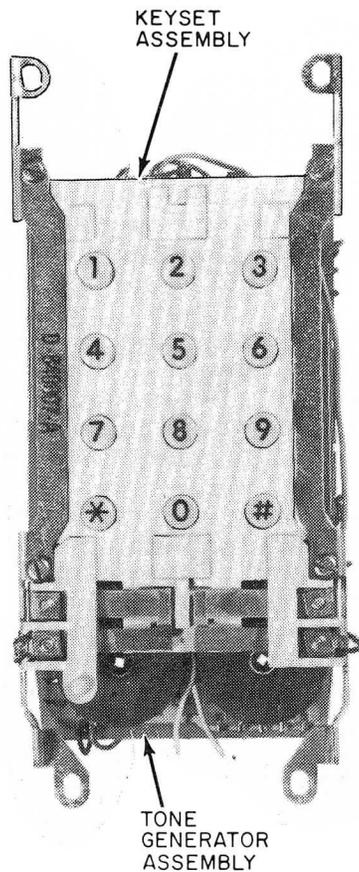


Figure 3. Touch Calling Unit D-840007.
Table 1. Touch Calling Unit Signal Frequencies.

DIGIT	CODE	FREQUENCY COMBINATION
1	L1 + H1	697 Hz + 1209 Hz
2	L1 + H2	697 Hz + 1336 Hz
3	L1 + H3	697 Hz + 1477 Hz
4	L2 + H1	770 Hz + 1209 Hz
5	L2 + H2	770 Hz + 1336 Hz
6	L2 + H3	770 Hz + 1477 Hz
7	L3 + H1	852 Hz + 1209 Hz
8	L3 + H2	852 Hz + 1336 Hz
9	L3 + H3	852 Hz + 1477 Hz
0	L4 + H2	941 Hz + 1336 Hz
ASTERISK	L4 + H1	941 Hz + 1209 Hz
#	L4 + H3	941 Hz + 1477 Hz

NOTE: 1,633 Hz is not used on standard 10- or 12-push-button Touch Calling Units.

2.05 Beryllium copper is used to provide a spring material with exceptionally high strength and fatigue endurance. The lever springs (and their contacts) and the top conductors with which they make are gold plated. This design allows sufficient follow after contact to provide a burnishing action between the contact springs and top conductors.

2.06 Each pushbutton also operates a common switch (Figure 7). After the frequency selection path is closed, the common switch performs the following functions:

- (a) Opens the short circuit around the resistor in series with the telephone receiver so that while the tones can be heard by the calling party, they are not loud enough to be objectionable.
- (b) Opens the circuit to the transmitter so that surrounding noises are not transmitted while the tones are being sent.
- (c) Closes the circuit to the tone generator.

2.07 The slide bar that actually moves the common switch is driven by a cam surface on each pushbutton. The slide bar starts moving shortly after a pushbutton closes its two sets of make contacts, and, as it is driven forward, an actuator cam on the end of the slide bar operates the common switch spring assembly.

Touch Calling Units D-840000, HD-840100, HD-840101, HD-840106, HD-840109 and HD-840120

2.08 Refer to Figures 8 through 16 for illustrations of the keysets in applicable TCU's. The keyset of each TCU employs a rocker shaft above each row and to the left of each column of pushbuttons in the assembly to translate their motion into shaft rotation for contact actuation. Figure 16 is a right elevation that shows the shaft ends for the four rows and the contact assembly for the 4 5 6 and * 0 # rows. The same setup is located on the left side of the base for the 1 2 3 and 7 8 9 rows. As shown schematically in Figure 8, the upper contact in each case is common and connected to the tank circuit of the low-frequency oscillator, while the lower contact on each side of the pile is wired to an individual coil tap. A similar contact assembly at the bottom of the base serves the 1 4 7 * and 3 6 9# pushbutton columns in controlling the high frequency oscillator, with a single contact set at the top of the 2 5 8 0 column.

2.09 Figure 13 shows a cross section taken through the * or # pushbutton as seen from the bottom of the column with the rocker shaft protruding toward the observer. Force applied to the top of the pushbutton causes the shaft to rotate clockwise, moving its external arm against the frequency selecting contacts. On the column shafts, an additional arm engages an acetal slide bar that operates the springs of the common switch located below the * 0 # key row.

2.10 As shown in Figure 14, the common switch contact arrangement includes a break set to pad the receiver and a transfer set to mute the transmitter and key the oscillator. The actuating card has a maximum capacity of five contact sets so that more complex contact arrangements (Figure 15) can be readily assembled for special service applications when required. Use of five springs in place of the former four provides a receiver pad circuit isolated from the transmitter mute contacts so that it may be inserted in the in-

duction coil side of the receiver path, rather than the common side. This permits adapting Touch Calling telephone sets to an amplifier-receiver handset without causing generation of distorted tones in the receiver during keying.

Touch Calling Unit HD-840107

2.11 Refer to Figures 17 and 18 for the associated illustrations of the D-840107 TCU: It is similar to the D-840000 TCU except for additional contact springs on the base plate assembly. These additional contact springs require more space and are consequently located in different positions on the base plate assembly than for the D-840000 TCU. The additional space is obtained by using hex stud spacers between the base plate assembly and the tone generator assembly. The location of the larger contact springs also requires a different location for the common switch (Figure 14). Since the larger contact springs are located away from the actuator rods, standoff plungers are required to actuate the lever springs.

Touch Calling Unit D-840007

2.12 Refer to Figures 19 through 22 for the associated illustrations of the keyset in TCU D-840007. The keyset

of the D-840007-A TCU consists of 12 pushbuttons measuring 0.240 inch in diameter, located on 0.560-inch centers to permit the 3 inches by 4 inches configuration to fit the space available in the handset. Because of the small diameter on each pushbutton, only the numerals, asterisk (*), and the number sign (#) are engraved on the pushbuttons. The alphabetic designations of a full metropolitan number plate, including OPER for the zero key, are printed in a white or gray paper mat inserted behind the faceplate at the time of assembly.

2.13 The keyset assembly construction is of a sloping radial design (Figure 22) with two metal mounting brackets extending along the outer edges of the keyset. Positioned below the mounting brackets are two plastic insert covers that enclose and protect the two contact assemblies on each side of the keyset. Unlike the other assemblies discussed in this section, the frequency-selecting lever springs are soldered directly to the printed wiring card that contains the cup-core coils and other discrete components of the two-transistor DTMF oscillators. The printed wiring card is fastened to the base of the keyset assembly with two pan-head screws and, because of its small area, is of double-sided construction, with etched copper conductive paths on both the upper and lower surfaces.

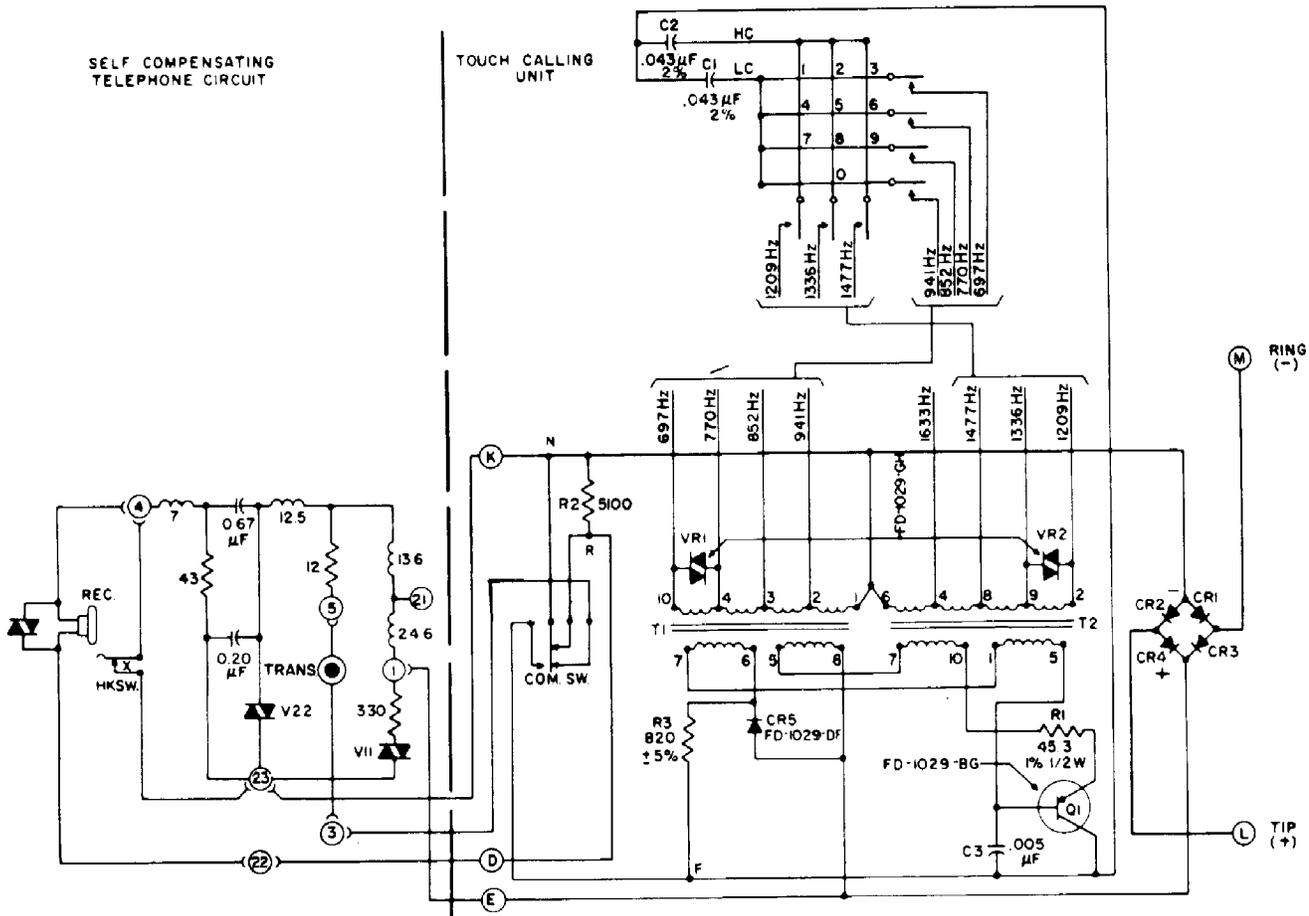


Figure 4. Schematic Diagram of TCU's D-84969 and D-84971.

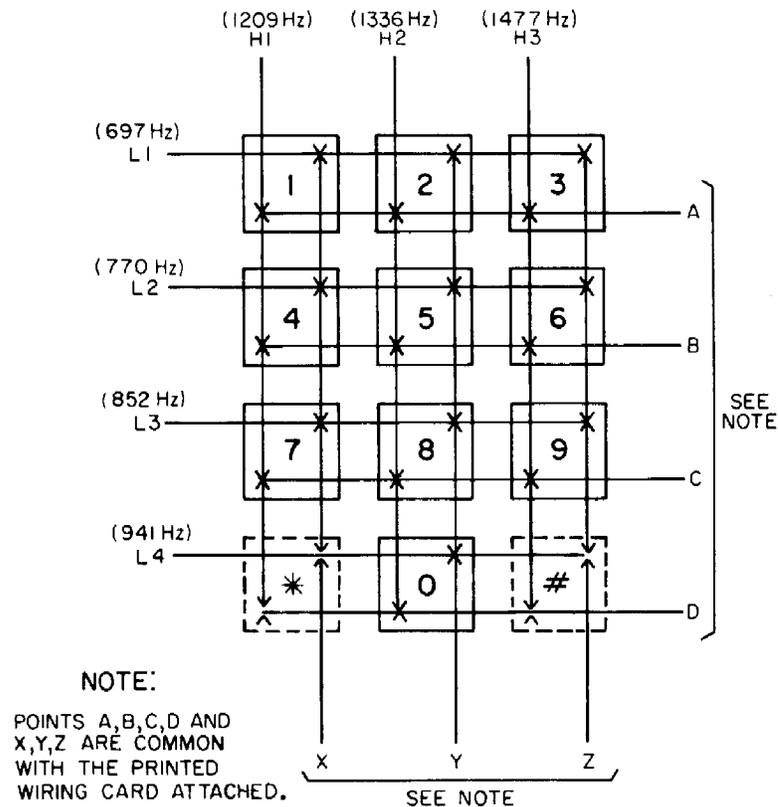


Figure 5. Wiring Diagram of Keyset in TCU's D-84969 and D-84971.

2.14 Located below the zero pushbutton on the keyset are four lever springs that actuate the recall switch when the recall pushbutton is depressed. The line connections from the switch are made by spade-ended leads that join those leads from the cord jack at the tie points on the transmitter nest clamps. The contacts on the set side are soldered directly to the card for connection to the diode bridge.

2.15 The contact assemblies of the D-840007 keyset are located as shown in Figure 19 to suit the mechanical requirements of the compact miniaturized keyset. The 1 4 7 * rocker shaft is placed to the right of that key column rather than to the left. For the 1 2 3 and 7 8 9 rows, the contact assemblies are located on the right side of the keyset and, for the 4 5 6 and * 0# rows, on the left side of the keyset. The contacts for the left column, which contains the 1 4 7 * designations, are located at the top of the keyset. The set of contacts associated with the 2 5 8 0 and 3 6 9# columns are located at the bottom of the keyset.

2.16 The common switch is centrally located under the keyset and fastened to a metal bearing plate that divides the keyset assembly from the tone generator card. The common switch actuation is derived from the row shafts, which engage an acetal slide bar operating vertically between the 1 4 6 * and 2 5 8 0 columns. Contacts for the common switch, in a standard break-and-transfer configuration, are centrally mounted on the rear of the unit beneath a clearance aperture cut out of the card.

Touch Calling Unit Tone Generator

2.17 The tone generators of the D-84969 and D-84971 TCU's are the same. The tone generators for all other TCU's, except D-840007, are functionally the same but physically different (Figures 12 and 21). The circuit for the tone generator used in the D-84969 and D-84971 TCU's is shown in Figure 4; the tone generator for the other TCU's in Figures 8 and 19.

2.18 A different pair of tones is used to represent each of the 10 or 12 digits and/or symbols. When a pushbutton is depressed, two pairs of contacts close to select one tone signal from a low group of frequencies (679 Hz, 770 Hz, 852 Hz, and 941 Hz), and one tone signal from a high group of three frequencies (1,209 Hz, 1,336 Hz, and 1,477 Hz). An additional frequency (1,633 Hz) is provided in the high group. This is provided as a spare frequency that can be used with each of the low group frequencies to derive four additional control signals. Additional pushbuttons on a separate key strip are required to control these frequencies.

2.19 The tone generator is assembled on a card mounted below the keyset. All eight tone frequencies (four high and four low) are produced by a one-transistor oscillator circuit, except in the D-840007 TCU, which has a two-transistor oscillator circuit. The frequency-determining components of the oscillator circuit consist of two variable tank circuits,

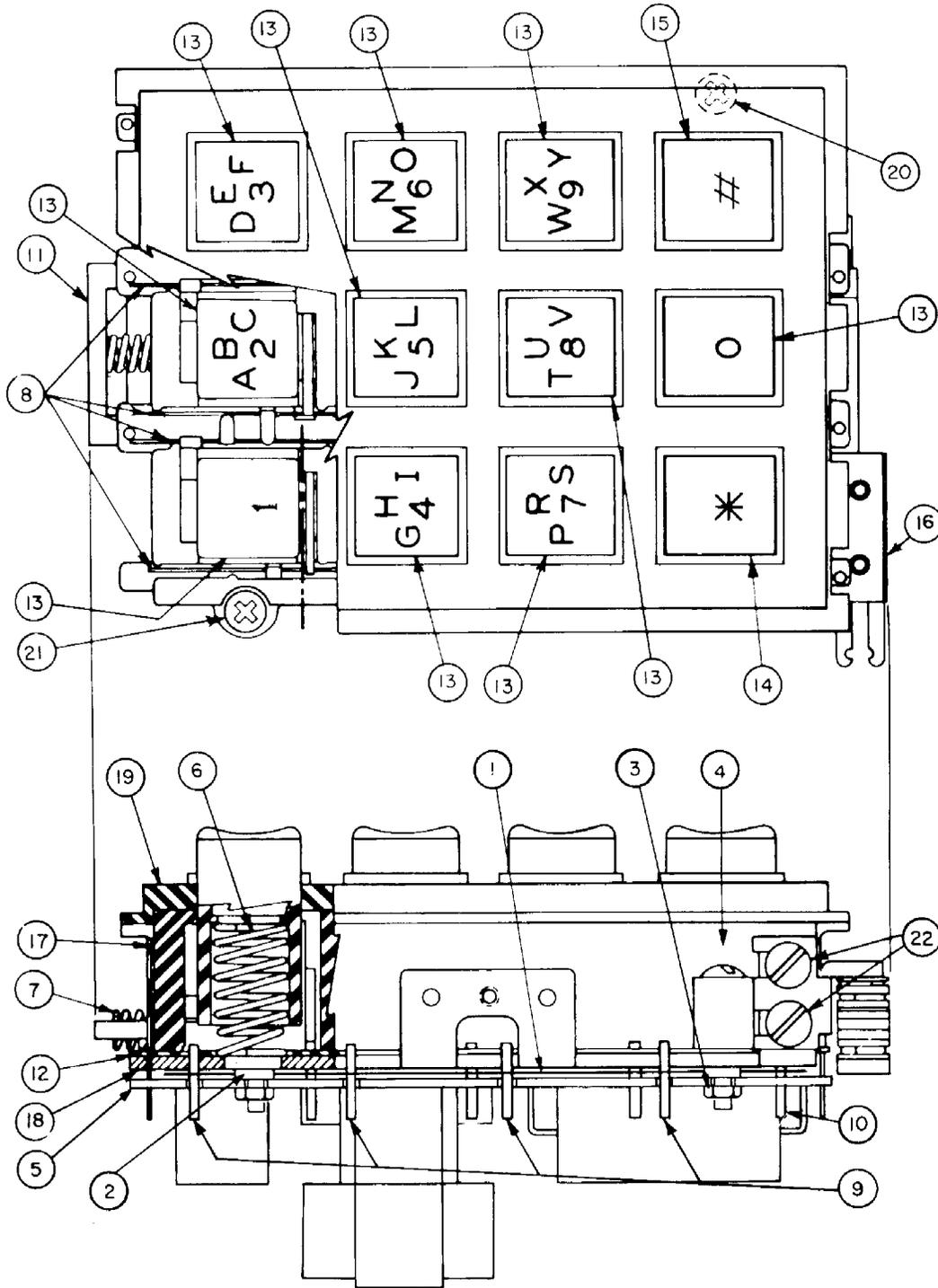


Figure 6. Location of Parts in TCU's D-84969 and D-84971.

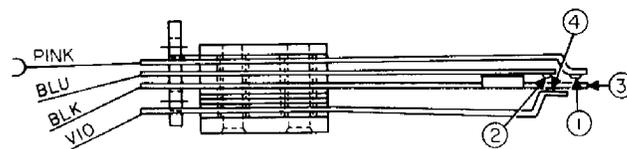


Figure 7. Common Switch for TCU's D-84969 and D-84971.

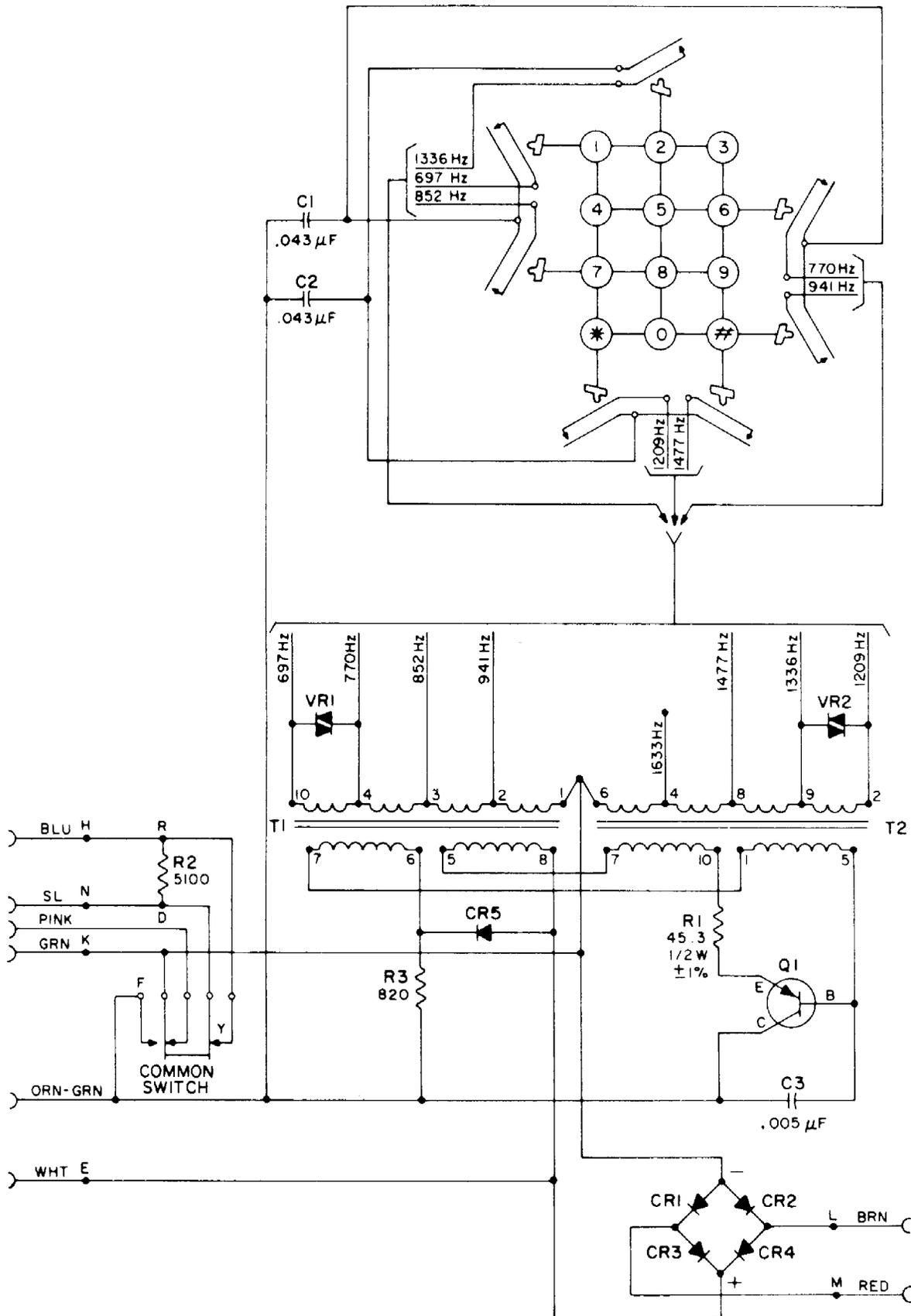


Figure 8. Schematic Diagram of TCU's D-840000, HD-840106, and HD-840109.

one for the high group of four frequencies and one for the low group. Low group frequencies are determined by transformer T1 and capacitor C1, while high group frequencies are determined by transformer T2 and capacitor C2. Each transformer has taps that make each tank circuit capable of producing four different frequencies.

2.20 The oscillator produces two frequencies at the same time and is operated midway between cutoff and saturation, never being driven into either. Since the oscillator is slow to start, shock excitation is used. When the two contacts of any depressed pushbutton connect capacitors C1 and C2 to transformers T1 and T2, respectively, the capacitors charge to line voltage. When the common switch is operated, the charged capacitors are connected across their associated tank coils. The discharge current flow through transformers T1 and T2 shocks the oscillator into oscillation.

3. ORDERING INFORMATION

3.01 Refer to Tables 2 through 7 for ordering information on all TCU's and associated parts.

4. MAINTENANCE

4.01 Maintenance instructions for similar TCU's are grouped together where practical. Touch Calling unit part

numbers are used to indicate the application of paragraphs to different TCU's.

General Maintenance of Touch Calling Units D-84969 and D-84971

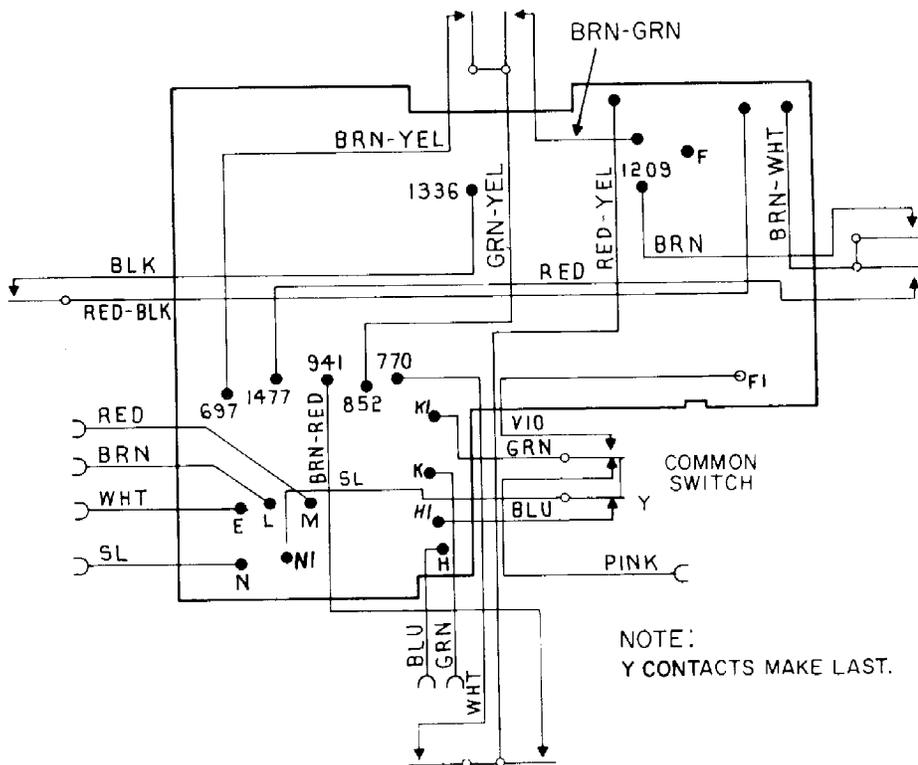
4.02 To prevent dust from affecting the contacts, the keyset must be kept clean. Dust, lint, or any other foreign matter should be blown out with clean, low-pressure (approximately 30 psi) compressed air whenever the subfaceplate is removed. This should be done just before reassembly.

4.03 Use the following procedure to clean the keyset:

- (a) Remove the subfaceplate (D-84969 and D-84971) by pressing firmly upward on the sides until the subfaceplate flanges disengage from the slots on the bearing plate.
- (b) If necessary, the springs may be burnished lightly with a contact burnisher such as the GTE Automatic Electric H-883699-1.
- (c) Blow any dust or lint out of the keyset with clean, low pressure (approximately 30 psi) compressed air.

NOTE: Do not use solvents on the contacts or attempt to lubricate the keyset.

- (d) Replace the subfaceplate.



NOTE:
 Y CONTACTS MAKE LAST.

Figure 9. Wiring Diagram of TCU's D-840000 and HD-840109.

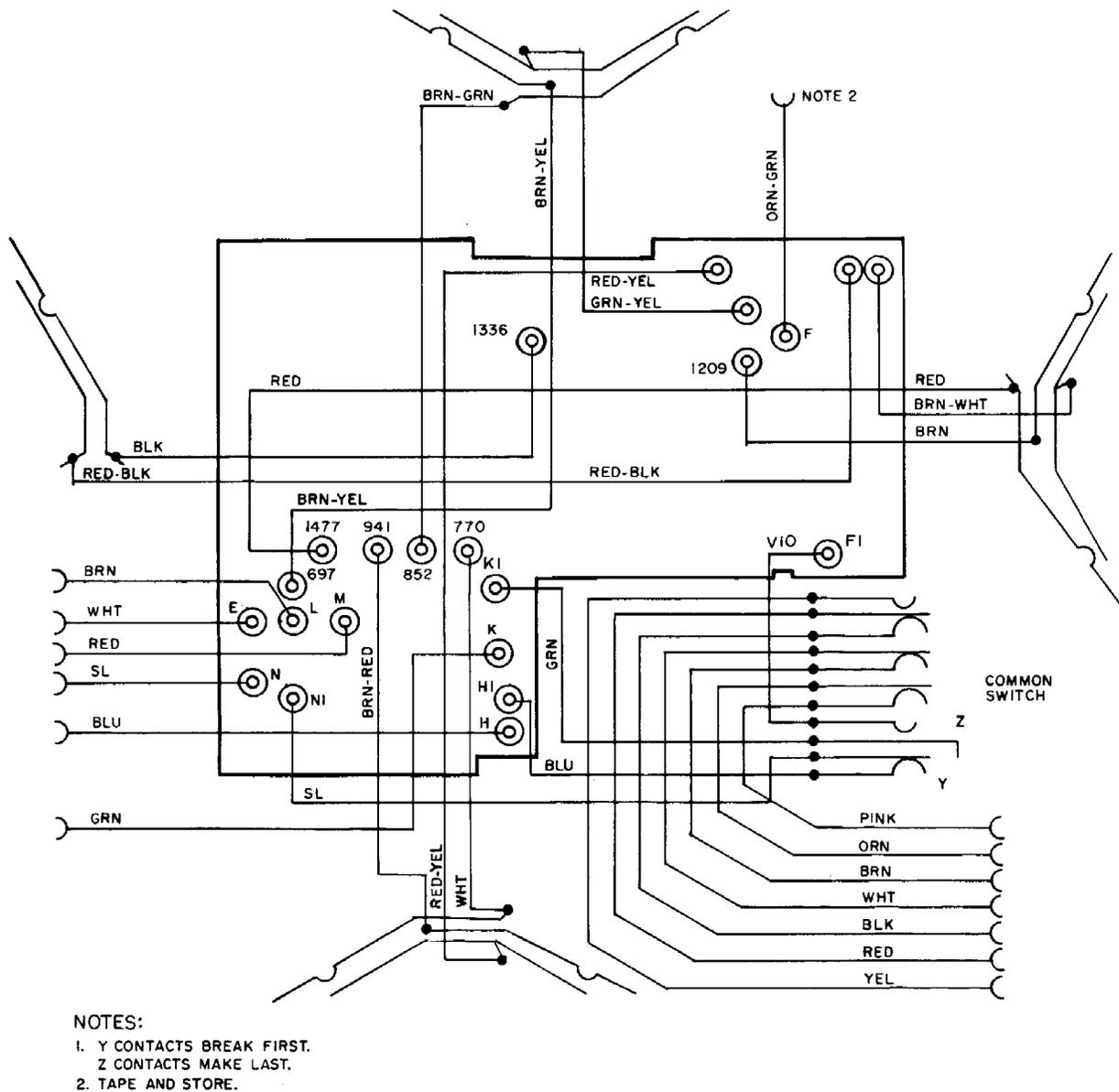


Figure 10. Wiring Diagram of TCU HD-840100.

Disassembly and Reassembly of Touch Calling Units
D-84969 and D-84971

4.04 Use the following procedure to separate the tone generator card from the keyset (Figure 6) when replacing either the keyset or the card:

- (a) Unsolder the four contact spring terminals from each side of the card and the three top conductor extensions from each end of the card (14 connections).
- (b) Remove the three small nuts that hold the card to the keyset.
- (c) Remove the card insulator (D-440482-A), and the three spacers. If only the card is being replaced, it is not necessary to remove the insulator and spacers.

4.05 To reassemble and reconnect the tone generator card to the keyset, use the following procedures:

- (a) Replace the three spacers and the insulator if they have been removed.
- (b) Replace the card.
- (c) Fasten with the three small nuts.

CAUTION: Do not overtighten these nuts because this may crack the card.

- (d) Solder the four contact spring terminals to each side of the card and the three top conductor extensions to each end of the card (14 connections).

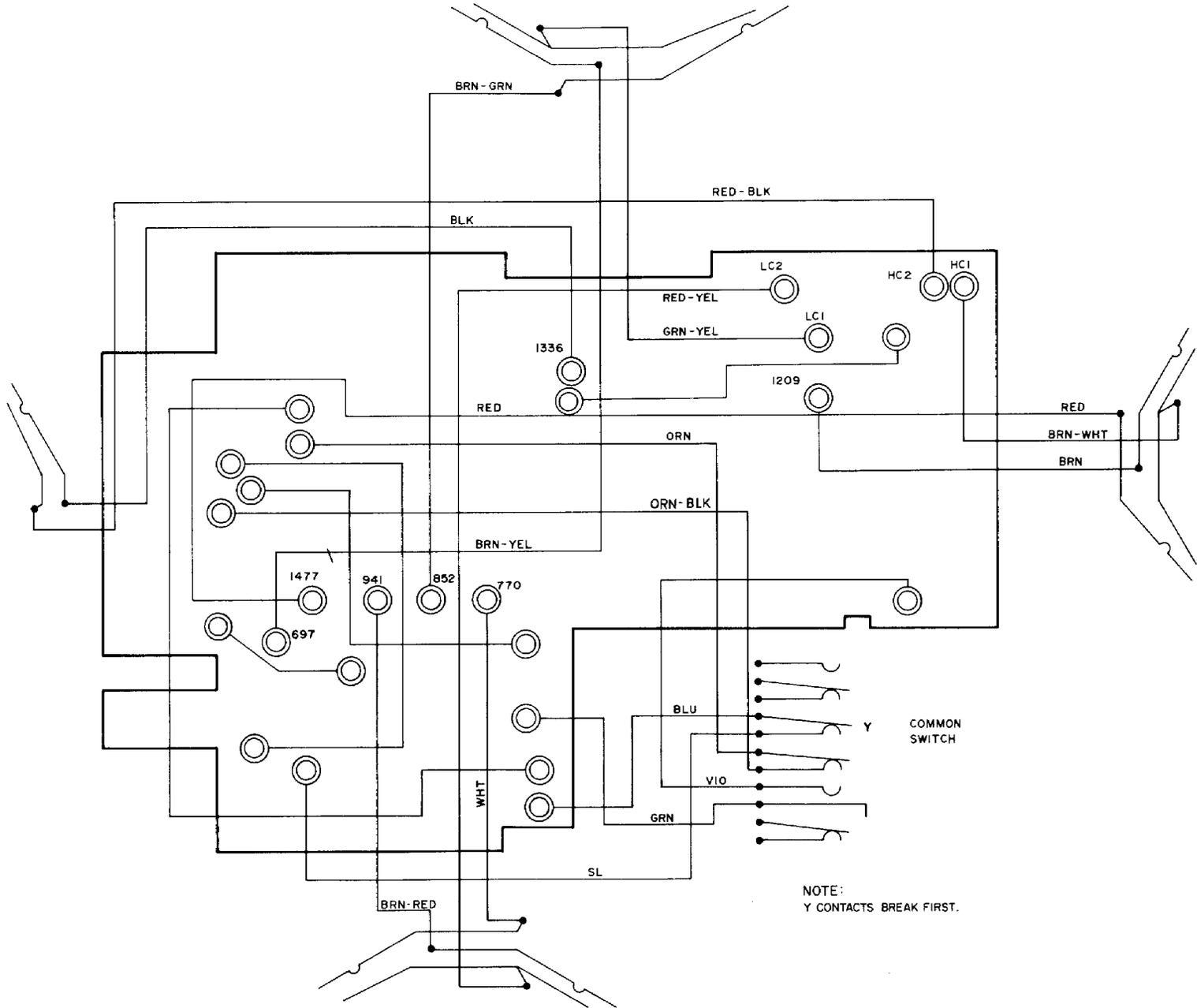


Figure 11. Wiring Diagram of TCU HD-840101.

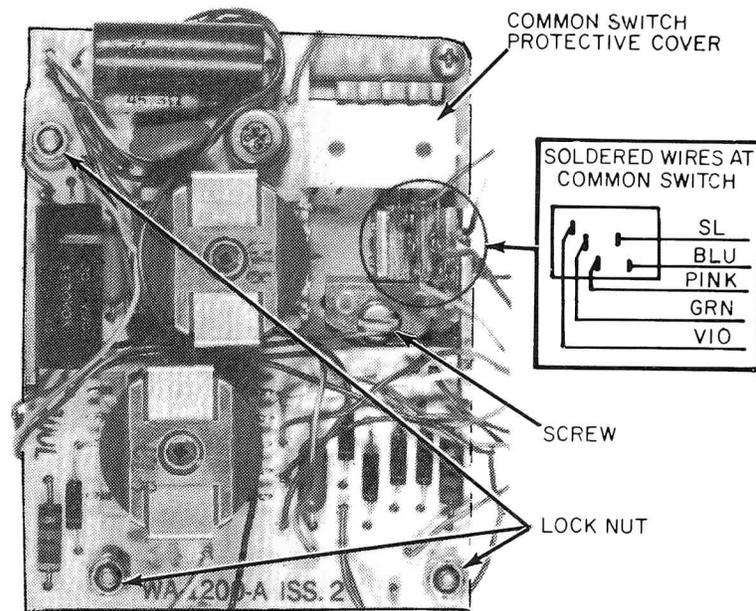


Figure 12. Tone Generator Assembly for TCU's D-840000, HD-840100, HD-840101, HD-840106, HD-840107, and HD-840109.

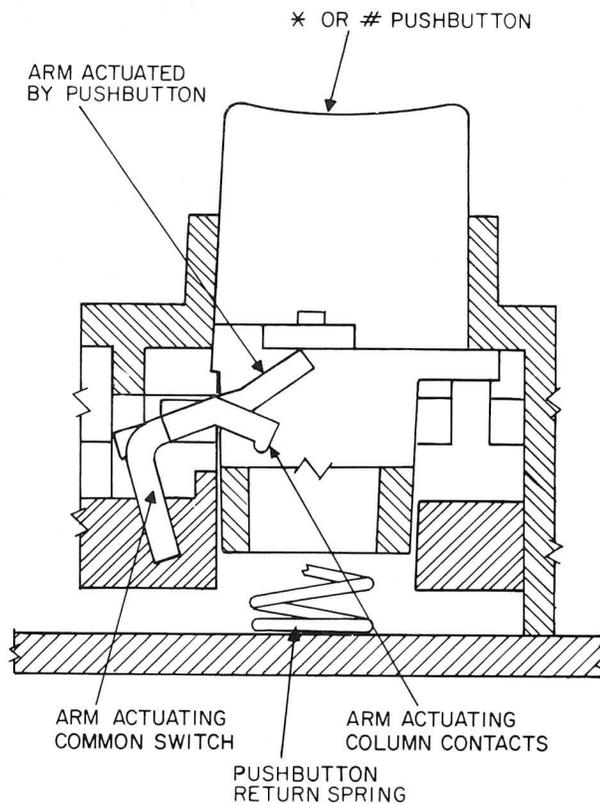


Figure 13. Cross Section of * or # Key in TCU's D-840000, HD-840100, HD-840101, HD-840106, HD-840107, and HD-840109.

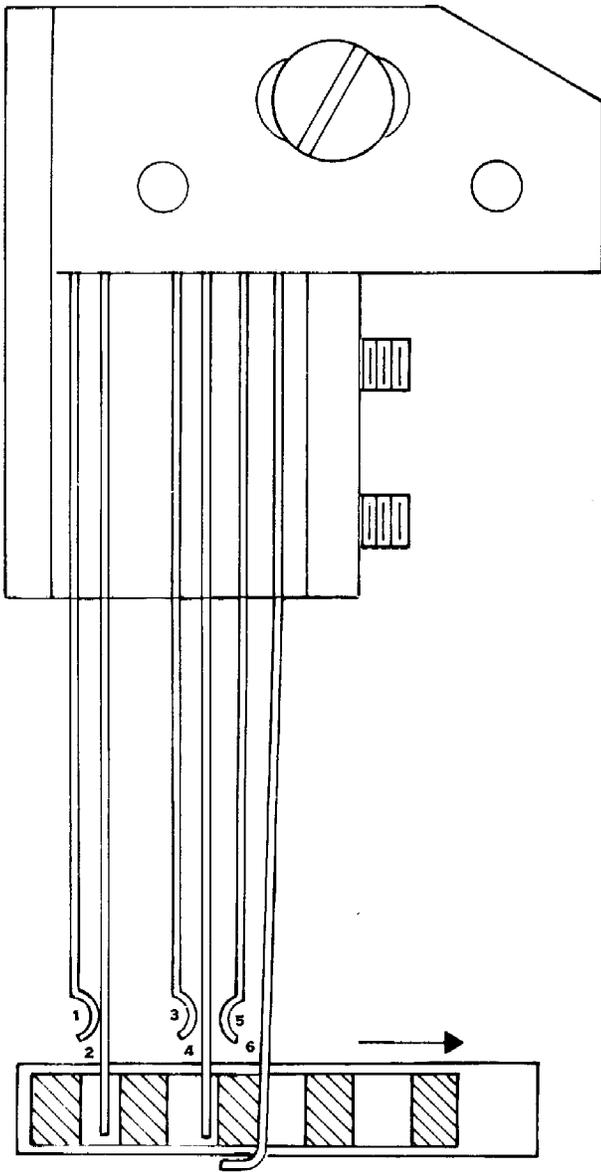


Figure 14. Small Common Switch.

Contact Spring Requirements for Touch Calling
Units D-84969 and D-84971

4.06 To inspect operation of the keyset, use the following procedure:

- (a) Remove the subfaceplate.
- (b) Check for bent, loose, or defective parts.
- (c) Check contact springs and top conductors for signs of wear, dirt, pitting, or metal transfer.
- (d) Operate the pushbuttons and visually check for proper operation.

NOTE: To prevent dust and lint from affecting the contacts, the keyset must be kept clean and

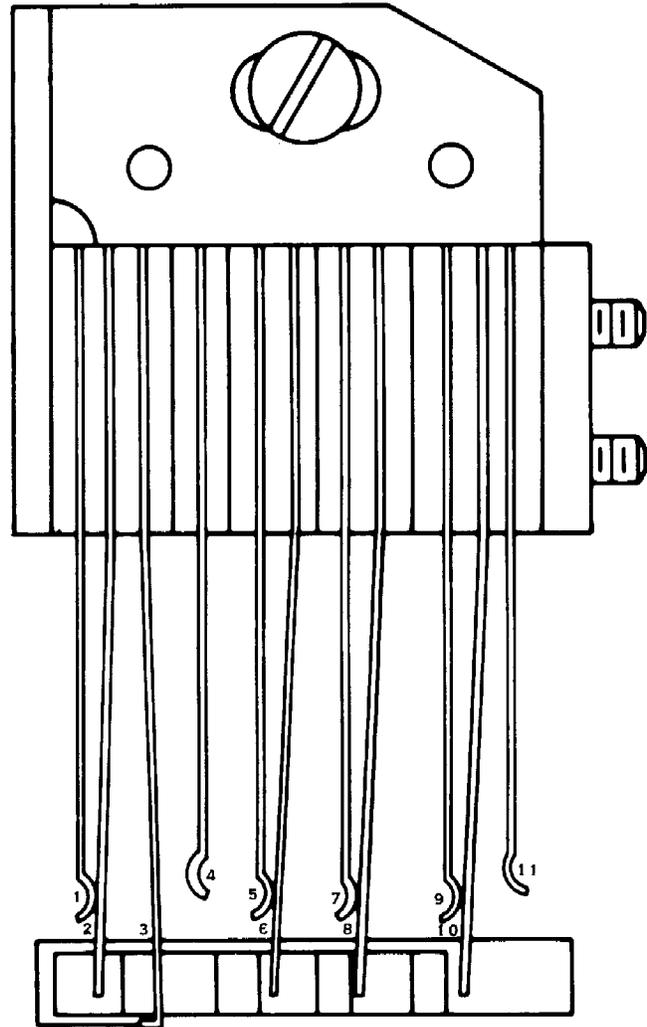


Figure 15. Large Common Switch.

should be blown out with clean, low-pressure (approximately 30 psi), compressed air whenever the subfaceplate is removed. This should be done just before reassembly.

4.07 If necessary, a continuity check may be performed on the keyset (preferably separated from the tone generator). Refer to Table 8 and Figure 5. Each digit should have two continuity checks. With the tone generator card connected to the keyset, points A, B, C, and D are common and points X, Y, and Z are common.

4.08 To replace contact springs, refer to paragraphs 4.12 and 4.13.

Common Switch Requirements for D-84969 and D-84971

4.09 As any one of the pushbuttons are depressed, check that the following contacts of the common switch (Figure 7) operate in the proper sequence:

- (a) As any pushbutton is depressed, contacts 2 and 3 on the common switch open first.
- (b) Next, contact 3 breaks from contact 1.
- (c) Finally, contact 3 makes with contact 4.

4.10 To remove the common switch use the following procedure:

- (a) Unsolder the following leads from their terminals on the common switch (Figure 7).

NOTE: The pink (spade-ended) lead may be left connected to the common switch. The spade-ended lead would normally go to the transmission board in a telephone set.

- (1) Blue lead from a terminal of spring 2.
 - (2) Black lead from the terminal of spring 3.
 - (3) Violet lead from the terminal of spring 4.
- (b) Remove the two screws that hold the common switch to the baseplate.
 - (c) Slip the common switch off, over the slide-bar cam.
 - (d) To replace the common switch, reverse the above procedure.
 - (e) Adjust the common switch according to the procedure in paragraph 4.11 after it is replaced on the unit.

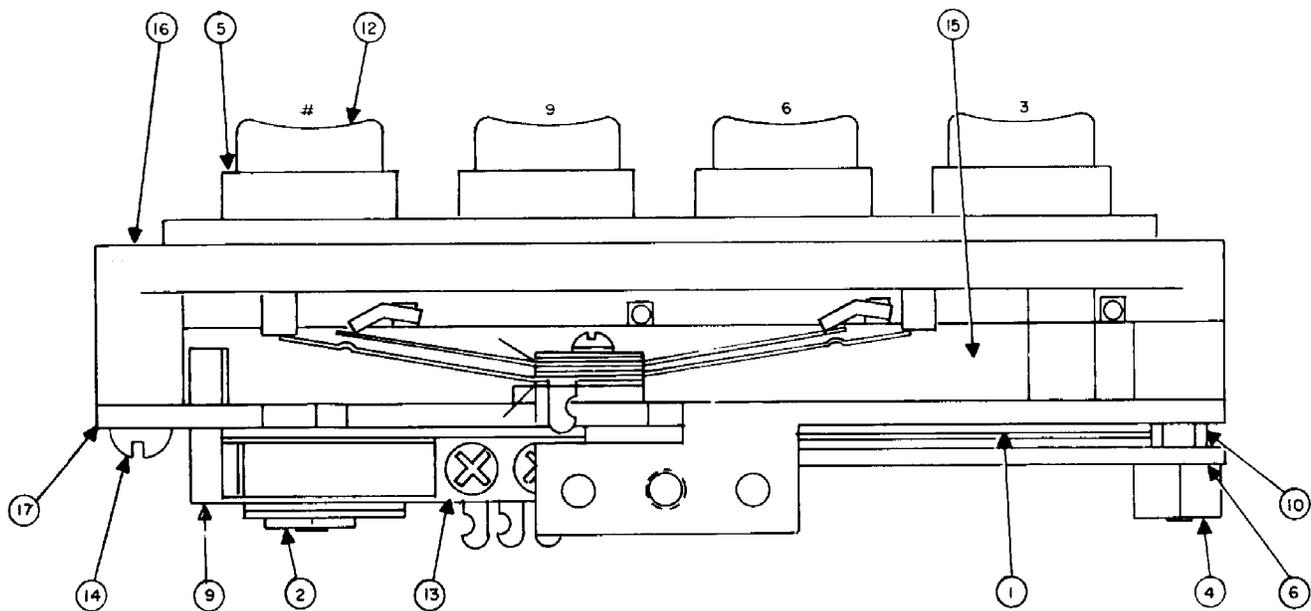
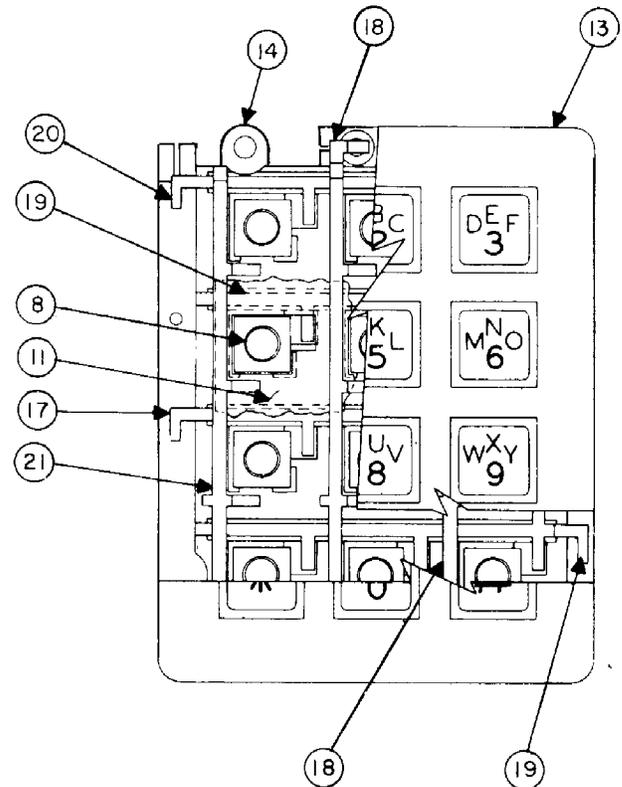


Figure 16. Location of Parts in TCU's D-840000, HD-840100, HD-840101, HD-840106, and HD-840109.

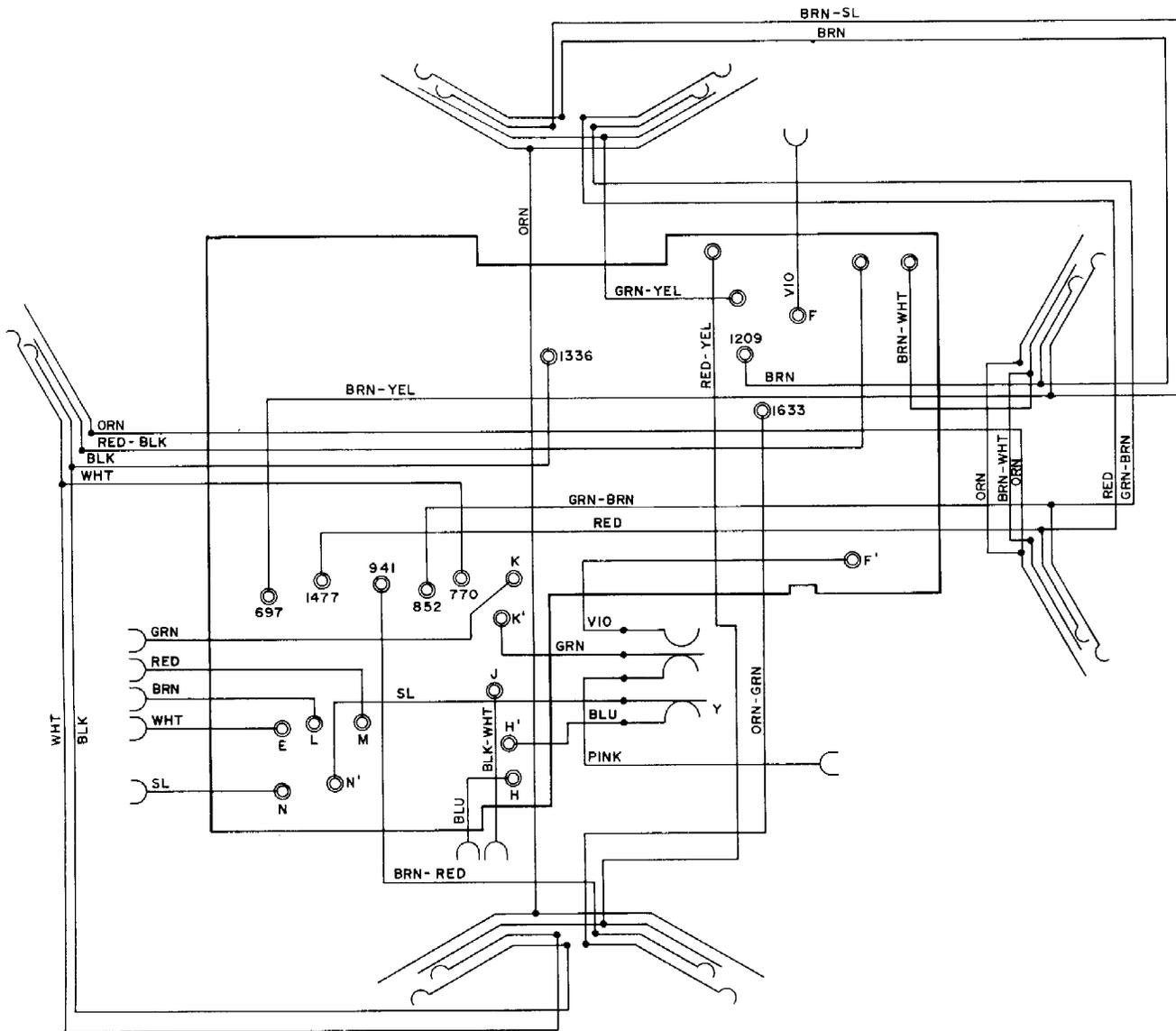


Figure 17. Wiring Diagram of TCU HD-840107.

4.11 The common switch should be adjusted to the following specifications:

- (a) The slide bar shall travel a minimum of 0.010 inch and a maximum of 0.020 inch from the nonoperated position before the lever spring begins to ride down the actuator cam.
- (b) There shall be a minimum perceptible gap of 0.005 inch between the lever spring and the slide bar surface when each pushbutton is individually and fully operated.
- (c) The lever spring shall exert a minimum 10-gram and maximum 15-gram force on the make spring when the slide bar is fully operated.
- (d) There shall be a minimum perceptible contact clearance of 0.010 inch between the lever spring and the outer break spring just as the make spring makes with the lever spring.
- (e) The inner break spring shall break first. There shall be minimum perceptible contact clearance of 0.005 inch between the inner break spring and the lever spring just as the outer break spring breaks.
- (f) The outer and inner break springs shall be adjusted so that the inner break spring has a minimum of 0.015 inch follow with the lever spring in the nonoperated position.
- (g) The slide bar shall rest against its stop in the nonoperated position. This requirement shall be considered to have been met only if the slide bar returns completely to its stop while the pushbutton is being restored slowly by hand.
- (h) After the make spring makes, there shall be at least a 0.025-inch stroke remaining in each pushbutton.

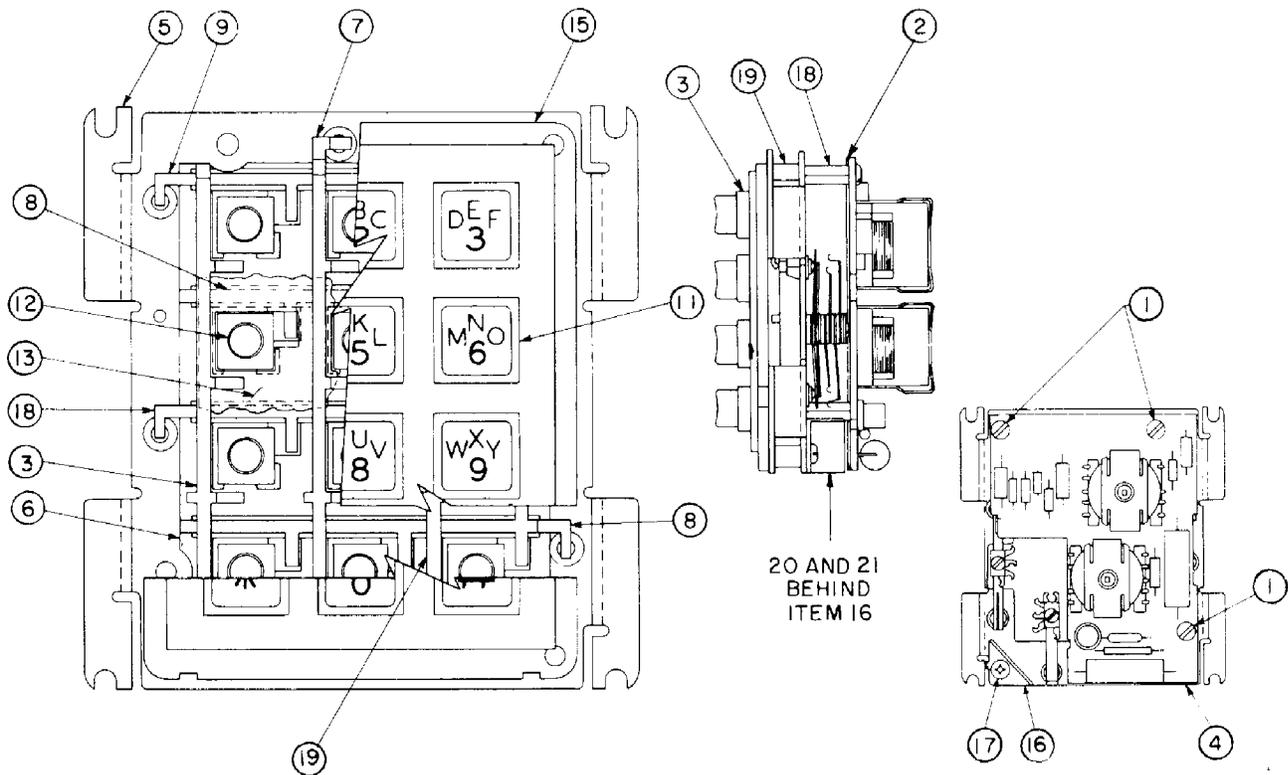


Figure 18. Location of Parts in TCU HD-840107.

Disassembly and Reassembly of Keyset in Touch Calling Units D-84969 and D-84971

4.12 Use the following procedure to disassemble the keyset if it is necessary to replace any of its components (refer to Table 2 for replacement parts):

- (a) Separate the keyset from the tone generator (refer to paragraph 4.04).
- (b) Remove the faceplate and subfaceplate.
- (c) Being careful not to bend them, remove the six top conductors as follows:
 - (1) Release the top conductors from their retaining catches (two per conductor) on top of the bearing plate (item 8, Figure 6).
 - (2) Lift the top conductor extensions out through their holes in the bearing plate and insulator (items 12 and 17, Figure 6).
- (d) Remove the common switch (refer to paragraph 4.10).
- (e) Carefully remove the three, long Phillips-head screws and one, short, Phillips-head screw that fasten the bearing plate to the baseplate.

WARNING: The pushbutton return springs are under compression; exercise care when removing the baseplate.

- (f) Remove the baseplate and lift out the insulator.
- (g) Lift out the pushbutton return springs from inside the base of the pushbutton (item 6, Figure 6).
- (h) Lift out the contact spring assemblies (near the round hole of the spring assembly), being careful not to bend springs or assemblies (six 3-leaf contact spring assemblies and two 1-leaf contact spring assemblies on the 10-pushbutton unit; or, eight 3-leaf contact spring assemblies on the 12-pushbutton unit).
- (i) Lift out the common switch slide bar and the slide bar return spring.
- (j) The pushbuttons may be lifted out through the bottom of the bearing plate.

4.13 Use the following procedure to reassemble the keyset:

- (a) Insert the pushbuttons through the bottom of the bearing plate in their proper numerical order (Figure 6).
- (b) Place the common switch slide bar in its slot in the bearing plate.
- (c) Insert contact spring assemblies and locate the round hole over the locating pin on the bottom of the bearing plate, and the other holes over their associated pins.
- (d) Compress the slide bar return spring and slip it into place.

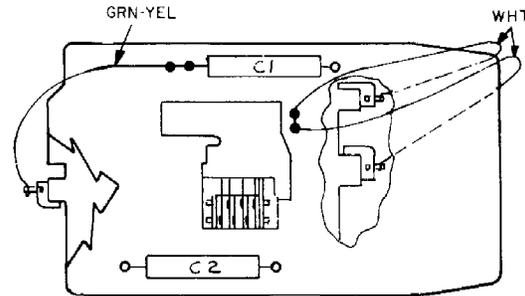
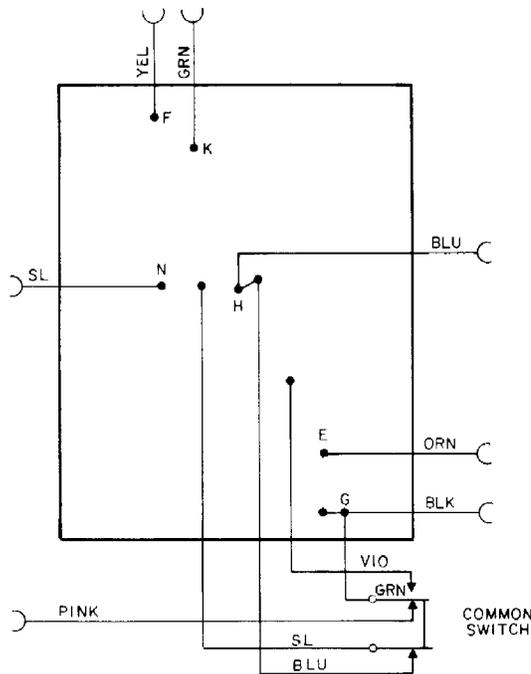


Figure 20. Wiring Diagram of TCU D-840007.

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| <p>(e) Place the insulator over the bottom of the bearing plate, locating the holes in the insulator on the pins on the bottom of the bearing plate.</p> <p>(f) Insert the pushbutton return springs into the push-buttons.</p> <p>(g) Press the baseplate into position over the springs, using the same alignment holes as the insulator.</p> <p>(h) Fasten the bearing plate to the baseplate (the baseplate has threaded holes) with the three long screws, and one short screw (located adjacent to where pushbutton No. 12 would be on a 12-pushbutton unit, or next to the # designated pushbutton on a 12-pushbutton unit).</p> <p>(i) Locate the top conductor extensions through their proper holes in the bearing plate and insulator, and press the top conductors into their catches on top of the bearing plate with a thin tool (such as a small screwdriver).</p> <p>(j) Replace the common switch.</p> <p>(k) Replace the subfaceplate and faceplate.</p> <p>(l) Reassemble and reconnect the tone generator card to the keyset (refer to paragraph 4.05).</p> <p>(m) Check to see that each spring is free to move and make contact as the pushbutton is operated.</p> <p>(n) To prevent dust and lint from affecting the contacts, the keyset must be kept clean and should be blown out with clean, low pressure (approximately 30 psi), compressed air whenever the subfaceplate is removed. This should be done just before reassembly.</p> <p><u>Disassembly and Reassembly of Touch Calling Units D-840000, HD-840100, HD-840101, HD-840106, HD-840109, and HD-840120.</u></p> <p>4.14 Disassemble the applicable TCU as follows (refer to Table 3 and Figure 16 for replacement parts):</p> | <p>(a) Remove common switch guard (item 2).</p> <p>(b) Unsolder all leads between the tone generator assembly (Item 6) and the baseplate and springs assembly (Item 17), as shown on the wiring diagram in Figure 9, 10, or 11.</p> <p>(c) Unsolder all leads between the tone generator assembly and the common switch if it is to be replaced (item 13) as shown on the applicable wiring diagram.</p> <p>(d) Remove three lock nuts (item 4).</p> <p>(e) Lift the tone generator assembly (Item 6) off the keyset assembly (Item 5).</p> <p>(f) Remove the insulator (item 1).</p> <p>(g) Remove the screw holding the common switch (item 13) and lift off the common switch.</p> <p>(h) Remove the three hex studs (item 10) and one screw (item 14).</p> <p>(i) Lift off the baseplate and springs assembly (item 17).</p> <p>(j) Remove parts from the subfaceplate (item 16) as required.</p> <p>4.15 Reassemble the applicable TCU as follows:</p> <p>(a) Install parts in the subfaceplate in the same positions as the parts were in when removed.</p> <p>(b) Install the baseplate and springs assembly using care to avoid damage to the contact springs.</p> <p>(c) Secure the baseplate and spring assembly using the three hex studs (item 10) and one screw (item 14).</p> <p>(d) Install the common switch, making sure the common switch actuator (item 9) is in proper position so that the ladder return spring is under tension. Also refer to Figure 15.</p> <p>(e) Transfer the leads from the old common switch to the new common switch if the switch was replaced.</p> |
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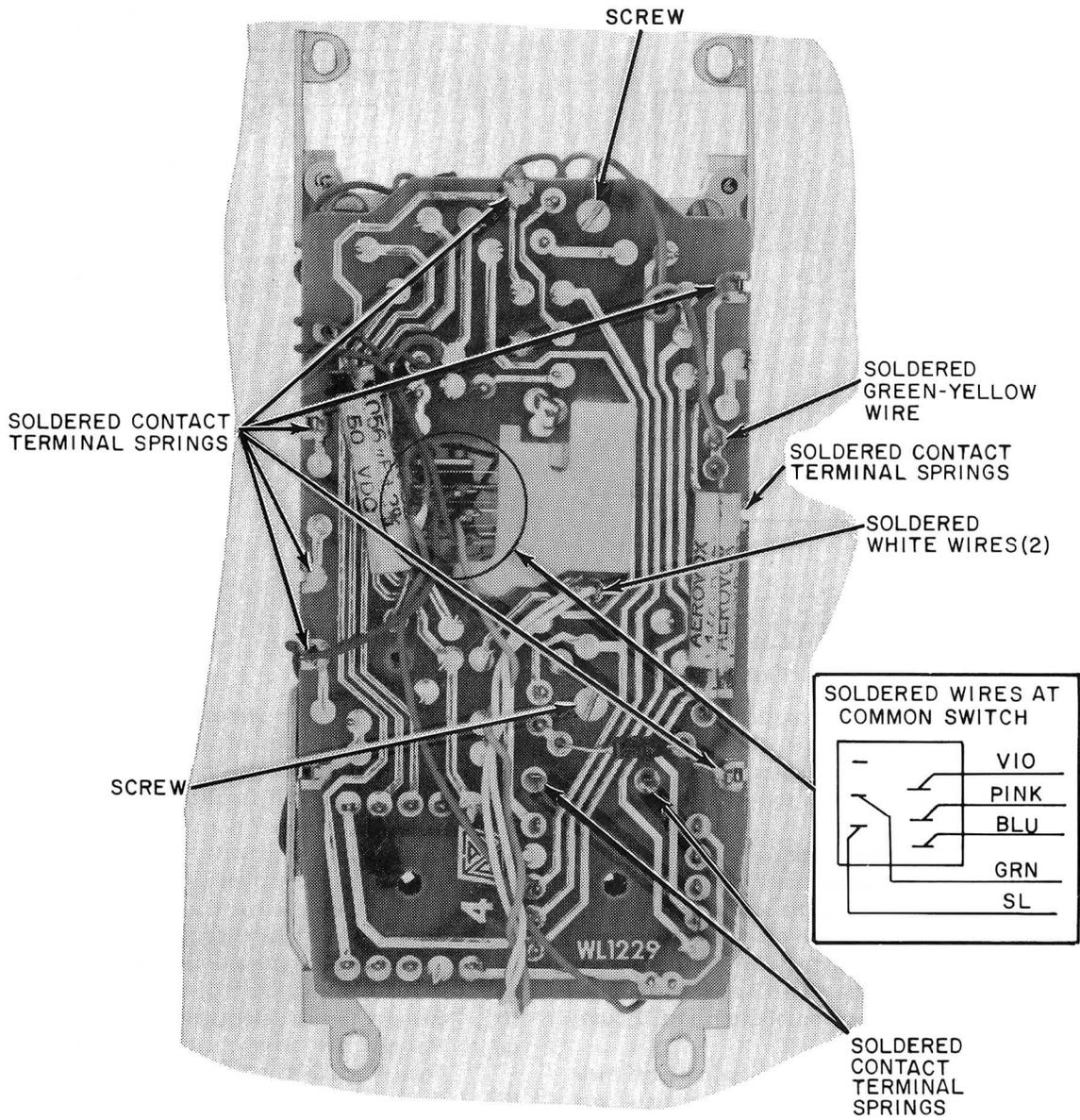


Figure 21. Tone Generator Assembly for TCU D-840007.

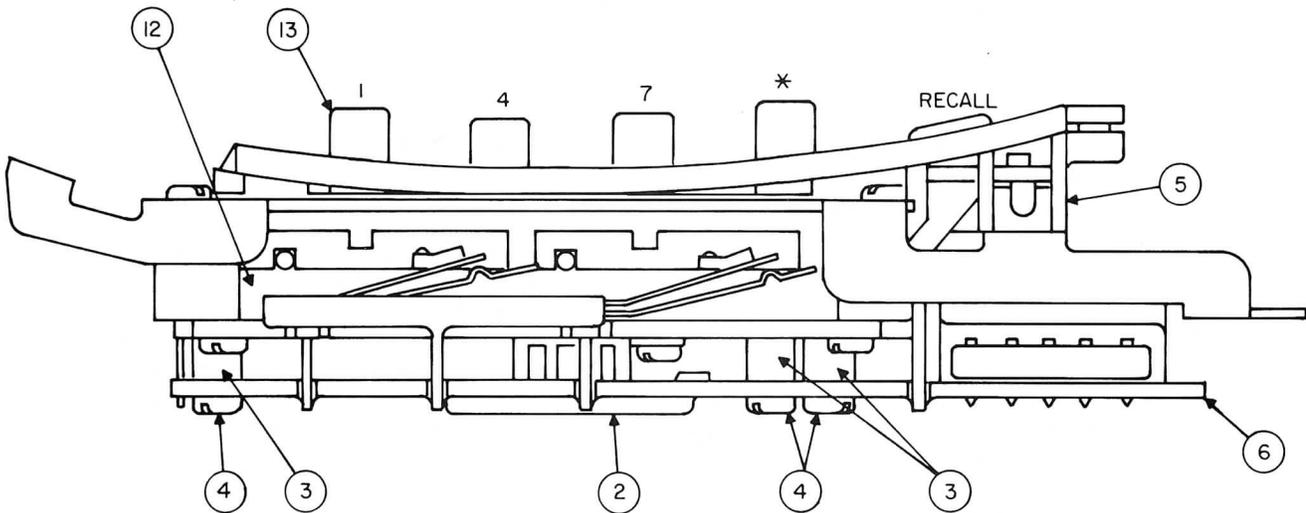


Figure 22a. Side View.

Figure 22. Location of Parts in TCU D-840007.

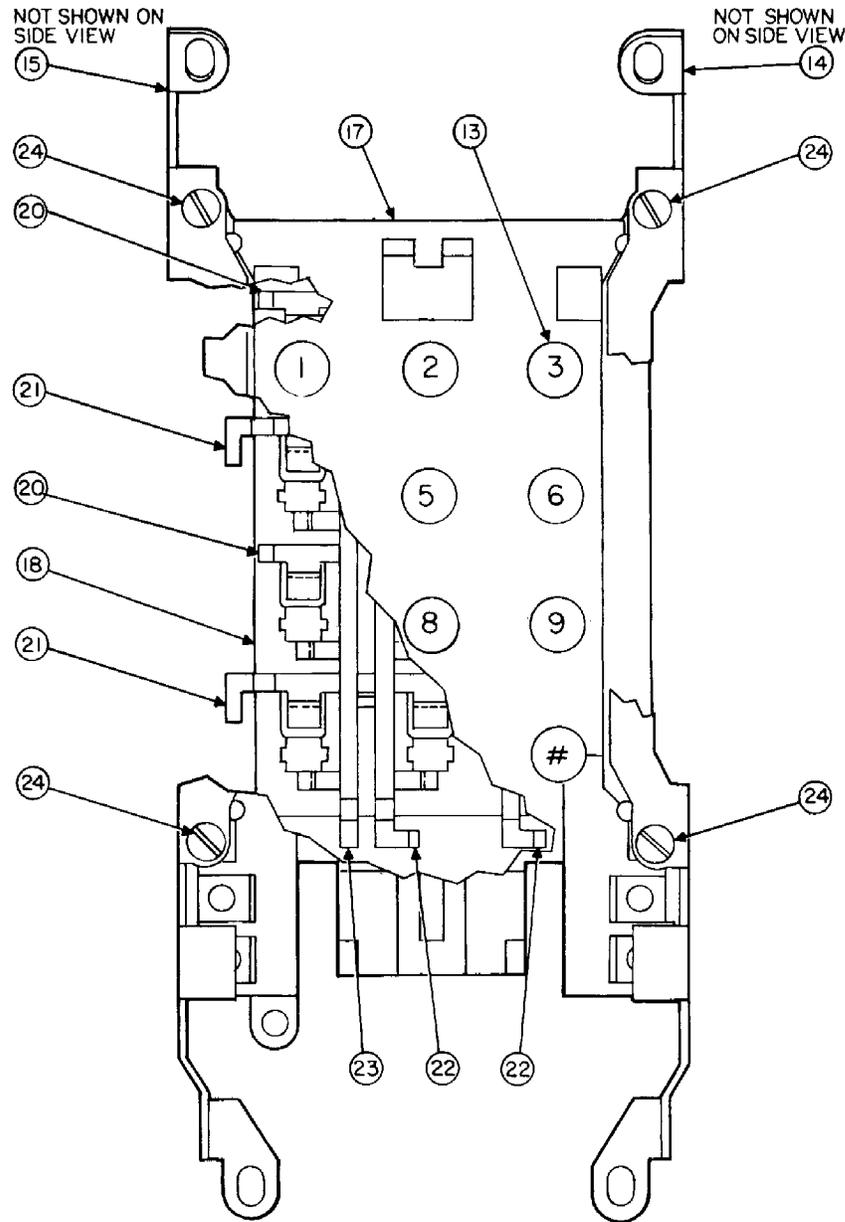


Figure 22b. Top View.
Figure 22. Location of Parts in TCU D-840007 (Continued).

- (f) Install the insulator (item 1).
- (g) Install the tone generator assembly (item 6) and secure it with the three locknuts (item 4).
- (h) Connect and solder all leads between the tone generator assembly (item 6) and the baseplate and springs assembly (item 17) as shown on the wiring diagram in Figure 9, 10, or 11.
- (i) Connect and solder all leads between the tone generator assembly and the common switch (item 13) as shown on the applicable wiring diagram.
- (j) Install the common switch guard (item 2).

Spring Contact Requirements for Touch Calling Units D-840000, HD-840100, HD-840101, HD-840106, HD-840109, and HD-840120

4.16 The requirements for the frequency springs are as follows:

- (a) The actuating springs shall make contact with the formed spring before the make contacts on the common switch make.

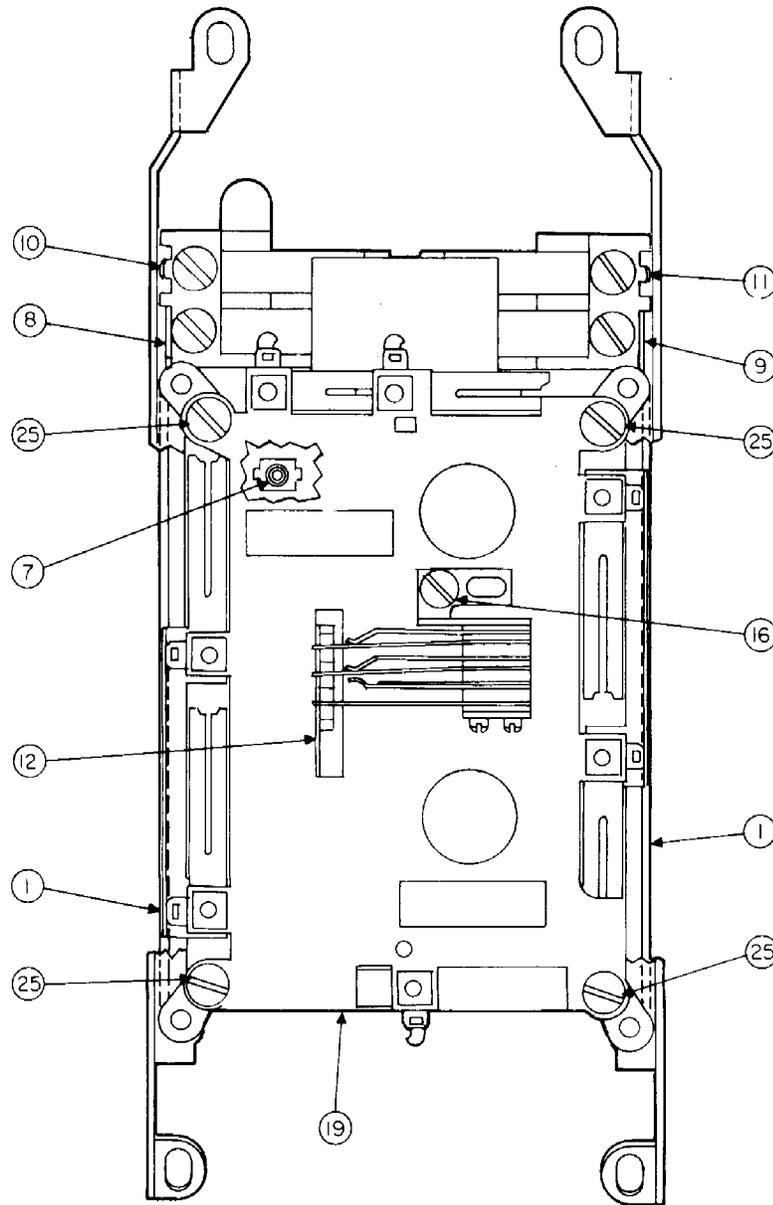


Figure 22c. Bottom View.
Figure 22. Location of Parts in TCU D-840007 (Continued).

- | | |
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| <p>(b) The actuating springs shall cause the actuator to rest against its associated stop with a minimum of 10 grams of tension as measured at the point adjacent to the outside tip of the actuator.</p> <p>(c) The formed spring shall rest against its stop with a minimum of 10 grams of tension as measured at the form on the side nearest the stop.</p> <p>(d) There shall be a minimum of 0.015 inch contact separation between the formed spring and the actuator spring in the nonoperated position.</p> | <p>(a) Depress each pushbutton sequentially and determine that the pushbutton causes the common switch actuator to travel the least amount. Use this pushbutton for adjusting the common switch.</p> <p>(b) Position the common switch on the baseplate so that the ladder actuator return spring shall have a minimum of 10 grams of tension against the ladder when the common switch is in the nonoperated position. The switch should be resting on its associated backsprings.</p> <p>(c) Upon depressing the pushbutton chosen in step (a), the common switch actuator shall travel a minimum of 0.020 inch before any spring contacts operate.</p> |
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4.17 The requirements for the common switches are presented in this paragraph. Steps that apply to particular TCU's are indicated by the applicable TCU part number. The requirements are as follows:

NOTE: Step (d) is for TCU's D-840000, HD-840106, HD-840107, and HD-840109 only.

- (d) Press the pushbutton picked in step (a) and check that the single contact springs break before the transfer contact springs break.
- (g) Depress the selected pushbutton and check that the first pair of make springs (springs 3 and 4) make before the first pair of break springs (springs 1 and 2) break.

NOTE: Steps (e) and (f) are for TCU HD-840101 only.

- (e) Depress the selected pushbutton and check that the third pair of break springs (7 and 8) break before the second pair of break springs break (5 and 6).
- (f) Depress the selected pushbutton and check that the single make spring (3 and 4) makes after all other spring contacts have operated.
- (h) Depress the selected pushbutton and check that the second pair of break springs (springs 5 and 6) break before the break springs of the transfer combination break.
- (i) Depress the selected pushbutton and check that the make springs of the transfer combination make after all other spring combinations have operated.
- (j) While meeting the requirements of step (g), the first pair of break springs shall operate as early as possible in the pushbutton stroke, i.e., long before the transfer combination makes.

NOTE: Steps (g) through (k) are for TCU HD-840100 only.

Table 2. Parts List for TCU's D-84969 and D-84971.

ITEM NO. (FIGURE 6)	DESCRIPTION	QUANTITY	ORDER NO.
TCU Assemblies D-84969-A and D-84971-A			
1	Insulator	1	D-440482-A
2	Spacer	3	D-7534-A
3	Nuts	3	D-77318-A
4	Keyset assembly: 10-pushbutton D-84969 12-pushbutton D-84971	1	D-84965-B D-84970-B
5	Tone generator assembly	1	WA-1127-A
Keyset Assemblies D-84965-B and D-84970-B			
6	Button return spring	10 or 12	D-109952-A
7	Slide bar return spring	1	D-109964-A
8	Top conductors	6	D-109994-A
9	Contact spring (one leaf)	6 or 8	D-109995-A
10	Contact spring (three leaves)	2	D-109995-B
11	Slide bar	1	D-16397-A
12	Insulator	1	D-440481-A
13	Pushbuttons Keyset assembly D-84965-B 1-0 (numerical designation only) Keyset assembly D-84970-B 1-0 (alphanumeric designation)	10	D-59339-A to H, J, and K D-59338-A to H, J, and K
14	Pushbutton *	1	D-59351-A
15	Pushbutton #	1	D-59351-B
16	Common switch	1	D-735524-A
17	Bearing plate	1	D-780957-A
18	Base Plate	1	D-780958-A
19	Subface plate	1	D-780978-A
20	Screw (short)	1	D-761061-F
21	Screw (long)	3	D-761061-J
22	Common switch mounting screw	1	F-6762-C

Table 3. Parts List for TCU's D-840000, HD-840100, HD-840101, HD-840106, HD-840109, and HD-840120.

ITEM NO. (FIGURE 16)	DESCRIPTION	QUANTITY	ORDER NO.
TCU Assemblies			
1	Insulator	1	D-440566-A
2	Common switch guard	1	D-440570-A
3	Pink wire assembly	1	D-543628-A
4	Locknut (0.112-40)	3	D-77386-D
5	Keyset assembly: All TCU's except HD-840109 TCU HD-840109	1	D-840000-C HD-840109-B
6	Tone generator assembly	1	WA-1200-A
7	Red clip wire	1	FD-1032-BP
Keyset Assemblies D-840000-C and HD-840109-B			
8	Pushbutton return spring	12	D-110041-A
9	Common switch actuator	1	D-16408-A
10	Hex stud	3	D-19476-A
11	Insulator	1	D-440567-A
12	Pushbuttons Keyset assembly D-840000-C 1-0 (alphanumeric designation) Keyset assembly HD-840109-B 1-0 (numeric designation only) * #	12	D-59375-A to H, J, and K HD-590004-A to H, J, and K HD-59004-L HD-59004-M
13	Common switch TCU's D-840000, HD-840106, and HD-840109 TCU's HD-840100 and HD-840101 and HD-840120		D-735558-A HD-735000-A
14	Screw	1	D-761097-F
15	Bearing plate	1	D-781046-A
16	Subfaceplate	1	D-781049-A
17	Base plate and springs assembly	1	D-781058-A
18	Actuator rod	1	D-83159-A
19	Actuator rod	2	D-83166-A
20	Actuator rod	2	D-83168-A
21	Actuator rod	2	D-83169-A
22	Screw	1	D-762046-B

Table 4. Parts List for TCU Kit D-840000-AR.

PART NO.	QUANTITY	DESCRIPTION
D-732229-A	1	Right-side bracket for Types 186/187 telephone sets.
D-732230-A	1	Left-side bracket for Types 186/187 telephone sets.
D-732231-A	2	Right- and left-brackets for Types 182A/192A telephone sets.
D-732233-A	1	Right-side bracket for Type 80 telephone set.
D-732234-A	1	Left-side bracket for Type 80 telephone set.
D-732242-A	2	Right- and left-side bracket for Type 95 telephone set.
D-762000-A	2	Flathead screws.
D-762032-A	2	Flathead screws.
D-762046-A	2	Phillips-head screws.
D-840000-A	1	Touch Calling unit.

(k) The following spring sequence is preferred but not mandatory, with the exceptions stated in steps (g) through (j).

<u>Sequence</u>	<u>Spring Operations</u>
1	Springs 3 and 4 make
2	Springs 1 and 2 break
3	Springs 5 and 6 break
4	Springs 9 and 10 break
5	Springs 7 and 8 break
6	Springs 10 and 11 make

- (l) The ladder actuator shall have a minimum of 0.010 inch additional travel after all contacts have operated.
- (m) See Figure 23 for adjustment sequence of HD-840120. The actuating springs shall have a minimum of 10 grams of tension against their associated back springs as measured at a point in line with the outer tip of the back spring when the common switch is in the nonoperated position.
- (n) The make springs shall have a minimum of 10 grams of tension in the fully actuated position as measured at the form in the spring.
- (o) The make springs shall have a minimum of 0.010 inch contact separation when the common switch is in the nonoperated position.
- (p) There will be a minimum of 0.020 inch contact separation between contacts not intended to make.

Disassembly and Reassembly of Touch Calling Unit D-840107

4.18 Disassemble the TCU as follows (refer to Figure 18 and Table 5 for referenced item numbers):

- (a) Remove three screws and washers (item 1).
- (b) Unsolder all leads between the tone generator assembly (item 4) and the baseplate assembly (item 5) as shown on the wiring diagram in Figure 17.
- (c) Unsolder all leads between the tone generator assembly and the common switch if either is to be replaced (item 20) as shown on the wiring diagram.
- (d) Remove the screw holding the common switch (items 20 and 21) and lift off the common switch.
- (e) Separate the tone generator assembly from the key-set assembly (item 3).
- (f) Remove the insulator (item 2).
- (g) Remove three standoffs (item 18), three spacers, and three hex studs (item 19).
- (h) Remove screw (item 17) and corner bracket (item 16).
- (i) Lift off baseplate assembly (item 5).
- (j) Remove parts from the subfaceplate (item 15) as required.

4.19 Reassemble the TCU as follows (refer to Figure 18 for referenced item numbers):

- (a) Install parts in subfaceplate (item 15) in the same position as the parts were when they were removed.
- (b) Install baseplate assembly (item 5) and secure with three hex studs (item 19) and corner bracket (item 16) and screw (item 17).
- (c) Install common switch making sure common switch actuator (item 8) is in proper position. Also refer to Figures 13 and 14.
- (d) Transfer the leads from the old common switch to the new common switch if switch was replaced.

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- (e) Connect and solder all leads between tone generator assembly (item 6) and common switch (item 20) as shown on wiring diagram.
- (f) Connect and solder all leads between tone generator assembly and baseplate assembly (item 5) as shown on wiring diagram.
- (g) Install insulator (item 2).
- (h) Install tone generator assembly (item 6) and secure with three screws and washers (item 1).

Spring Contact Requirements for Touch Calling Unit D-840107

4.20 The requirements for the seven frequency springs are as follows:

- (a) The actuators shall contact the actuating springs at a point approximately in line with the centerline of the actuating springs.

- (b) The actuating springs shall make contact with the formed springs before the make contacts on the common switch make.
- (c) The actuating springs shall cause the actuator to rest against its associated stop with a minimum of 10 grams of tension as measured at the point adjacent to the outside rim of the actuator.
- (d) The actuating spring shall cause a minimum follow of 0.020 inch on the formed springs when button is fully depressed.
- (e) The disabling or outer spring and the frequency spring shall make within 0.005 inch of each other.
- (f) There shall be a minimum of 0.015 inch contact separation between the disabling or outer spring and the actuator spring.

4.21 Refer to paragraph 4.17 for the common switch requirements.

Table 5. Parts List for TCU HD-840107.

ITEM NO. (FIGURE 19)	DESCRIPTION	QUANTITY	ORDER NO.
TCU Assembly			
1	Screw and washer	3	D-762044-B
2	Insulator	1	D-440566-A
3	Keyset assembly	1	HD-840107-B
4	Tone generator assembly	1	HB-1007-A
Keyset Assembly HD-840107-B			
5	Baseplate assembly	1	HD-780046-A
6	Bearing plate	1	D-781046-A
7	Actuator rod	1	D-83159-A
8	Actuator rod	2	D-83166-A
9	Actuator rod	2	D-83168-A
10	Actuator rod	2	D-83169-A
11	Common switch actuator	1	HD-160009-A
12	Pushbutton return spring	12	D-110041-A
13	Insulator	1	D-440567-A
14	Pushbuttons 1-0 (alphanumeric designation) * #	12	D-59375-A to H, J, and K HD-59004L HD-59004M
15	Subfaceplate	1	D-781049-A
16	Corner bracket	1	HD-731028-A
17	Screw (.112-24 x 1/2)	1	D-761097-F
18	Standoff	3	HD-190010-A
19	Hex stud	3	D-19476-A
20	Common switch	1	D-735558-A
21	Common switch screw	1	D-762046-B
22	One-conductor cord (pink)	1	D-543628-A

Table 6. Parts List for TCU D-840007.

ITEM NO. (FIGURE 22)	DESCRIPTION	QUANTITY	ORDER NO.
TCU Assembly D-840007-A			
1	Guard	2	D-440599-A
2	Common switch guard	1	D-440600-A
3	Spacer	3	D-750359-A
4	Spacer screw	3	D-761119-D
5	Keyset assembly	1	D-840007-B
6	Tone generator assembly	1	WA-1229-A
Keyset Assembly D-840007-B			
7	Return spring	12	D-110085-A
8	Recall spring	1	D-110098-A
9	Recall spring	1	D-110099-A
10	Recall spring	1	D-110100-A
11	Recall spring	1	D-110101-A
12	Common switch actuator	1	D-16407-A
13	Pushbuttons 1-0 (numerical designation only) * #	12	D-59382-A to H, J, and K D-59382-L D-59382-M
14	Mounting bracket	1	D-732256-A
15	Mounting bracket	1	D-732257-A
16	Common switch	1	D-735571-A
17	Subfaceplate	1	D-781070-A
18	Bearing plate	1	D-781071-A
19	Base plate	1	D-781073-A
20	Actuator rod	2	D-83173-A
21	Actuator rod	2	D-83174-A
22	Actuator rod	2	D-83175-A
23	Actuator rod	1	D-83176-A
24	Mounting screws	4	
25	Base plate screws	4	

Disassembly and Reassembly of Touch Calling Unit
D-840007

4.22 Use the following procedure to separate the tone generator card from the keyset (Figure 3) when replacing either the keyset or the tone generator (refer to Table 6 for replacement parts):

- (a) Unsolder the nine contact terminal springs from the sides of the card (Figure 21).
- (b) Unsolder the green-yellow, and white leads from the card, and the green, violet, slate, pink, and blue leads from the common switch located as shown in Figures 20 and 21.
- (c) Remove the two screws shown in Figure 21.

(d) Unsolder the two contact terminal springs located toward the interior of the card (Figure 21) while pulling the card from the keyset.

(e) Remove the three spacers (item 3, Figure 22) so they do not fall off and become lost.

4.23 To reassemble and reconnect the tone generator card to the keyset, use the following procedure:

- (a) Check that the orange, green, black, blue, violet, yellow, and slate leads are soldered to the underside (transistor side) of the card in the same manner as on the removed card.
- (b) Check that the two holes for the contact terminal springs located toward the interior of the card are free of solder.

Table 7. Components for Adapting TCU D-840000 to Various Telephone Sets.

PART NO.	DESCRIPTION
D-490211-*R	Housing kit for Types 182 and 182A
D-490212-*R	Housing kit for Type 192A
D-490163-*R	Housing assembly for Type 192A (including hookswitch plunger and bearing pin)
D-490211-*	Housing only for Type 182 and 182A
D-490212-*	Housing only for Type 192A
D-67684-A	Hookswitch plunger for Type 192A
D-37728-A	Plunger bearing pin for Type 192A
D-780988-*	TC unit adapter plate for Type 182A and 192A
D-732232-A	Dial mounting bracket for Type 182, 182A and 192A
D-58084-A	Acetal bar to mount old TCU (kit has two)
D-761113-G	4-24 x 1/2 inch flat Phillips hd. self-tapping screw (to fasten TCU bracket through housing to TCU adapter plate; two required to mount new TCU)
D-761097-F	4-24 x 1/2 inch pan Phillips hd. self-tapping screw (to fasten through washer and housing to TCU adapter plate; two required to mount old TCU)
D-731944-A	Housing mounting bar for Type 182 only
D-760997-A	4-40 x 1/4 inch round head self-tapping screw (to fasten bar to housing, Type 182 only; two required)

* Indicates Color Suffix

Table 8. Keypad, Continuity Checks.

DIGIT	CONTINUITY CHECK POINTS
1	L1 to X and H1 to A
2	L1 to Y and H2 to A
3	L1 to Z and H3 to A
4	L2 to X and H1 to B
5	L2 to Y and H2 to B
6	L2 to Z and H3 to B
7	L3 to X and H1 to C
8	L3 to Y and H2 to C
9	L3 to Z and H3 to C
0	L4 to Y and H2 to D
ASTERISK	L4 to X and H1 to D
#	L4 to Z and H3 to D

- (c) Install the three spacers (item 3, Figure 22) by pressing the spacers in place.
- (d) Place the 3 spacers on the tone generator card and place the tone generator card in position on the keypad using card to locate the 11 contact terminal springs in their proper positions.
- (e) Install the two screws shown in Figure 22.
- (f) Solder the green-yellow, white, green, violet, slate, pink, and blue leads in position as shown in Figure 21.
- (g) Solder the eleven contact terminal springs in place.

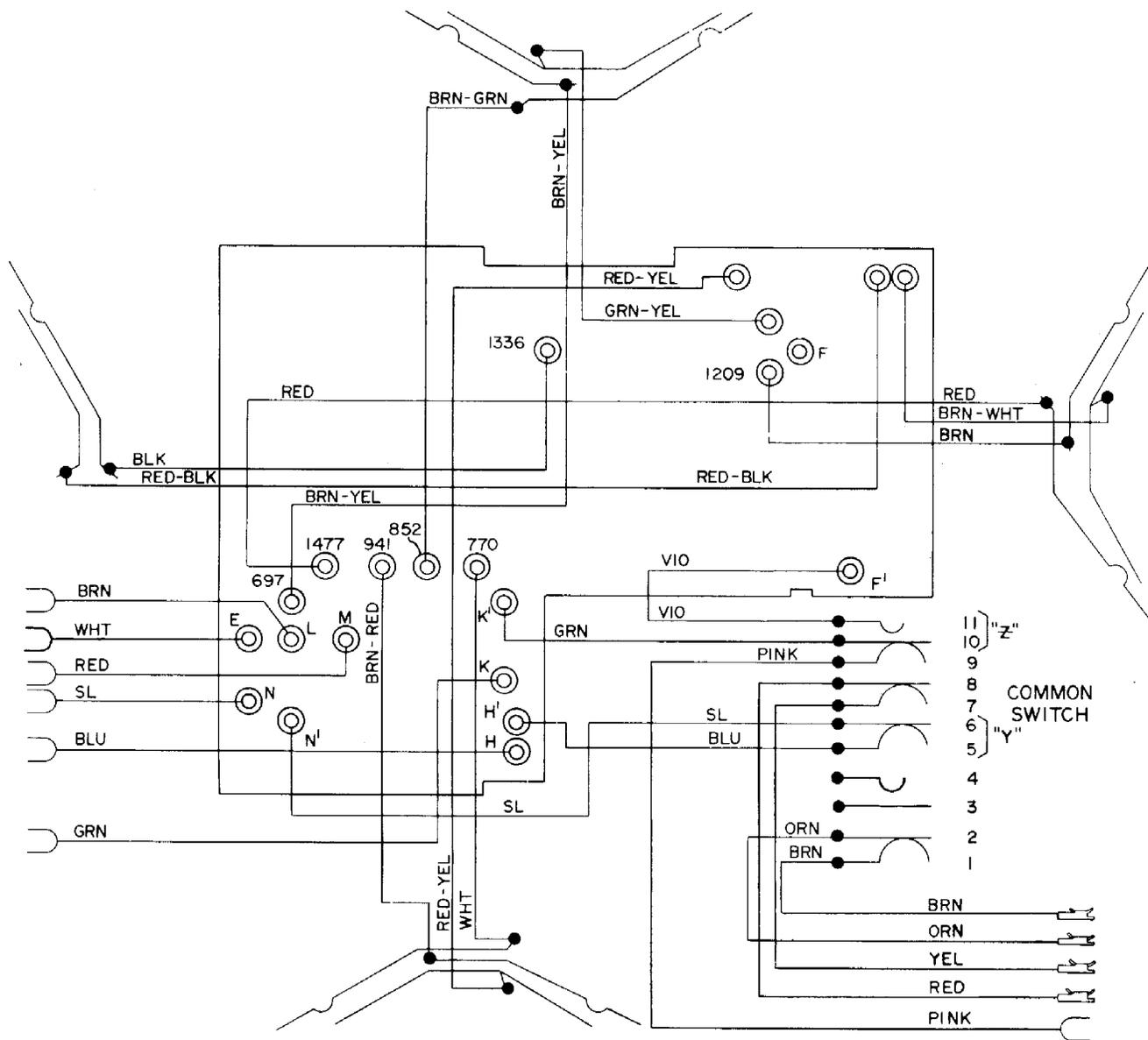
Disassembly and Reassembly of Keypad Assembly D-840007-B

4.24 Use the following procedure to disassemble the keypad if it is necessary to replace any of its components (refer to Figures 22 (a, b, and c) for referenced item numbers):

- (a) Separate the keypad from the tone generator (refer to paragraph 4.22).
- (b) Remove screw and common switch (item 16).
- (c) Remove the two mounting brackets (items 14 and 15) by removing the four (item 24) mounting screws.
- (d) Remove two item 1 guards.
- (e) Remove four screws and baseplate (items 25 and 19).
- (f) Lift off common switch actuator (item 12).
- (g) Remove screw and carefully lift off bearing plate (item 18). All parts in the subfaceplate (item 17) may now be removed.
- (h) Remove screws with nuts and recall springs (items 8, 9, 10, and 11).

4.25 Use the following procedure to reassemble the keypad (refer to Figure 22 for referenced item numbers):

- (a) Assemble all the parts in the subfaceplate (item 17). Check that all pushbutton numbers are oriented properly.
- (b) Install bearing plate (item 18) and check that pushbuttons are free to operate. Secure bearing plate with screw.
- (c) Install common switch actuator (item 12).
- (d) Install baseplate (item 19) very carefully to avoid damage to the spring contacts along the sides of the baseplate. (The make springs should rest on their stops.) Secure baseplate with four screws. Check that pushbuttons are free to operate.
- (e) Install recall springs (items 8, 9, 10, and 11) using screws with nuts.
- (f) Install common switch (item 16) using screw, so that ladder return spring is under tension.
- (g) Adjust to requirements of paragraphs 4.26 and 4.27.
- (h) Install two guards (item 1).
- (i) Install two mounting brackets (items 14 and 15) using four screws (item 24).



- NOTES:
1. SPRINGS USED IN SPEAKERPHONE MODE IN ORDER OF OPERATION:
COMMON SWITCH CONTACTS 7 AND 8 BREAK, CONTACTS 1 AND 2 BREAK, CONTACTS 10 AND 11 MAKE.
 2. SPRINGS USED IN HANDSET MODE IN ORDER OF OPERATION:
COMMON SWITCH CONTACTS 5 AND 6 BREAK, CONTACTS 9 AND 10 BREAK, CONTACTS 10 AND 11 MAKE.
 3. NOTES 1 AND 2 ARE NOT ELECTRICALLY RELATED EXCEPT THAT THE CONTACTS 10 AND 11 COMBINATION STARTS THE TOUCH-CALLING OSCILLATOR. CONTACTS 7 AND 8 AND CONTACTS 1 AND 2 SEQUENCE (ELECTRICALLY OPERATIVE ONLY IN SPEAKERPHONE MODE) SHOULD TAKE PLACE AS EARLY AS POSSIBLE IN THE PUSHBUTTON STROKE. TWO CAPACITORS IN THE TOUCH-CALLING UNIT MUST CHARGE BETWEEN THE TIME CONTACTS 1 AND 2 BREAK AND THE TIME THAT CONTACTS 10 AND 11 MAKE AND OSCILLATION ACTUALLY STARTS. THE CHARGING TIME MAY BE AS LONG AS 2 MILLISECONDS.

Figure 23. Wiring Diagram of TCU HD-840120.

Spring Contact Requirements for Touch Calling Unit D-840007

4.26 The requirements for the seven frequency springs are as follows:

- (a) The actuating springs shall make contact with the formed springs before the make contacts on the common switch make.
- (b) The actuating springs shall rest against their associated actuators with a minimum of 10 grams of tension as measured at the point adjacent to the outside tip of the actuator.
- (c) The actuating spring shall cause a minimum follow of 0.020 inch on the formed springs when pushbutton is fully depressed.
- (d) The formed spring shall rest against its stop with a minimum of 10 grams of tension as measured at the form on the side nearest the stop.
- (e) There shall be a minimum of 0.015 inch contact separation between the formed spring and the actuator spring in the nonoperated position.

4.27 The requirements for the common switch springs are as follows:

- (a) Press each pushbutton sequentially and determine the pushbutton that causes the common switch actuator to travel the least amount. This pushbutton shall be used for checking the requirements of the common switch.
- (b) Upon depressing the pushbutton chosen in (a), the ladder actuator of the common switch shall travel a minimum of 0.020 inch before the spring contact breaks.
- (c) To ensure proper follow through of the pushbuttons, the ladder actuator shall travel on additional minimum of 0.010 inch after all contacts have operated.
- (d) The ladder actuator return spring shall have a minimum of 10 grams of tension against the ladder when the common switch is in the nonoperated position.
- (e) The common switch actuator springs shall have a minimum of 10 grams of tension against their associated back springs as measured at a point in line with the outer tip of the back spring when the common switch is in the nonoperated position.

- (f) The make springs shall have a minimum of 10 grams of tension, as measured adjacent to the form in the spring, when the common switch is fully operated.
- (g) The make springs shall have a minimum of 0.010 inch contact separation when the common switch is in the nonoperated position.
- (h) There shall be a minimum of 0.020 inch contact separation between contacts not intended to make.
- (i) The single break springs shall break before the transfer break springs break.

4.28 The requirements for the recall switch springs are as follows:

- (a) There shall be a minimum of 0.015 inch clearance between the back spring and the back spring stop when the recall switch is in the nonoperated position.
- (b) The back spring shall rest against its actuating spring with a minimum of 15 grams of tension as measured from the outer center nearest the back spring contact.
- (c) With the recall button fully depressed, there shall be a minimum of 0.015 inch contact separation.

5. TONE GENERATOR TEST PROCEDURE

5.01 The procedures in this part are provided for testing and adjusting all TCU tone generator assemblies.

Preliminary Connections

5.02 The following connections should be made before making tests or adjustments:

- (a) Connect the tone generator card to a standard Touch Calling self-compensating telephone circuit (Figures 6 and 8). If the card is separated from the keyset, simulate the keyset with toggle switches to connect capacitor C1 to the taps on transformer T1, and capacitor C2 to the taps on transformer T2. Use another toggle switch to simulate make springs of the common switch.
- (b) Battery feed is to be from a 49 ± 1 Vdc source through a standard 200-200 ohm battery feed coil (D-283998-A) with arrangements to switch to either zero or 1600-ohm loop. Terminate the circuit with a 900-ohm load. A suggested test circuit is shown in Figure 24.

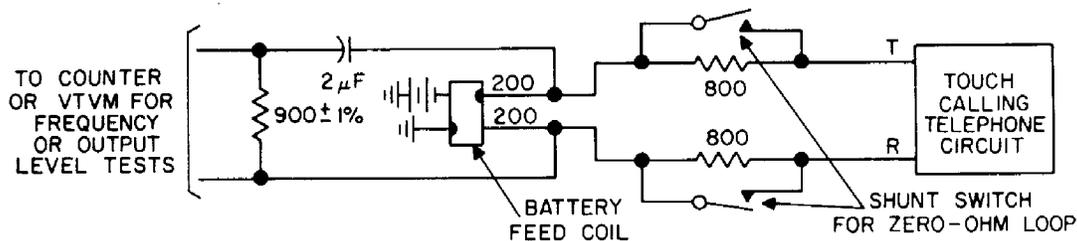


Figure 24. Tone Generator Assembly Test Circuit.

Test Equipment

5.03 Take frequency and output level measurements across the 900-ohm termination. Frequency may be measured with a standard counter (Transistor Specialties Inc., APTI/meter 361, or equivalent), output level with an ac vacuum tube voltmeter (Hewlett-Packard 400L or equivalent), and waveform may be checked for distortion or clipping with an oscilloscope (Tektonix Model 502, or equivalent). Care should be taken to be sure that the inputs to all instruments are isolated from ground.

NOTE: Make all adjustments and measurements with the ambient temperature at $77 \pm 2^{\circ}\text{F}$.

Frequency Adjustment-Zero-Ohm Loop

5.04 Make the following frequency checks and adjustments with the loop resistance set at zero ohms. Use G.C. Electronics New Transistor I.F. core alignment tool, Type 9940, or equivalent, to make transformer adjustments.

NOTE: For the following checks, it may be necessary to restore and reoperate the common switch after each frequency selection to shock-excite the oscillator into oscillation.

5.05 To allow measurement of the frequencies from transformer T1, short circuit any two of the taps on transformer T2 to prevent it from oscillating while making adjustment measurements on transformer T1 and do the following:

- (a) Connect capacitor C1 to the 770-Hz tap on transformer T1.
- (b) Adjust transformer T1 so that the counter reads exactly 770 Hz.
- (c) Connect, in turn, capacitor C1 to the 697, 852, and 941 Hz taps.
- (d) The counter should read the correct frequency at each tap, within ± 2 Hz.

5.06 If this procedure is followed and the frequencies are off more than ± 2 Hz at any tap, then an alternate adjustment is permissible. The frequency may be deliberately set off by as much as ± 2 Hz at one tap to allow the frequencies at the other taps to fall within ± 2 Hz.

5.07 To allow measurements of the frequencies from transformer T2, short circuit any two of the taps on transformer T1 to prevent the transformer from oscillating while making adjustment measurements on transformer T2.

- (a) Connect capacitor C2 to the 1,336-Hz tap on transformer T2.
- (b) Adjust transformer T2 so that the counter reads exactly 1,336 Hz.

- (c) Then connect capacitor C2 in turn to the 1,209-, 1,477-, and 1,633-Hz taps.
- (d) The counter should read the correct frequency within ± 3 Hz.

5.08 If the above procedure is followed and the frequencies are off more than ± 3 Hz at any tap, then an alternate adjustment is permissible. The frequency may be deliberately set off by as much as ± 3 Hz at one tap to allow the frequencies at the other taps to fall within ± 3 Hz.

Frequency Adjustment 1,600-Ohm Loop

5.09 Switch the 1,600-ohm (long) loop into the test circuit and repeat the procedures in paragraphs 5.05 through 5.08. The frequencies should not vary more than ± 1 Hz from the values on each tap, established by the zero loop frequency adjustment. There should not be any perceptible clipping or distortion of the waveform observed on the oscilloscope for either short or long loops.

Output Levels

5.10 The rms levels measured across the 900-ohm termination should be within the limits given for each frequency group in Table 9. Make the output level test as follows:

- (a) Connect an ac vacuum tube voltmeter across the 900-ohm termination.
- (b) Depress the pairs of pushbuttons indicated in Table 10 to obtain single frequency output.
- (c) Measurements should correspond to the rms levels shown in Table 9.

Final Frequency Check

5.11 Recheck the frequencies when the tone generator has been installed in a telephone by operating the pairs of pushbuttons in Table 10 to obtain only one frequency to measure on the counter.

5.12 A frequency of 1,633-Hz cannot be readily checked without disassembling the telephone. It may be assumed that it is correct if the frequencies in Table 10 are correct, inasmuch as the 1,633-Hz frequency level was checked on the card prior to assembly into the telephone.

NOTE: The standard 12-pushbutton Touch Calling unit does not use a 1,633-Hz frequency.

5.13 A final functional test on the assembled telephone should be conducted by depressing each pushbutton in turn and noting that a pair of frequencies is sent and that the frequencies are properly registered on a test receiver (Touch Calling Test Receiver H-850679-A, or equivalent).

Table 9. RMS Levels.

	ZERO LOOP NOMINAL	1600-OHM LOOP NOMINAL
Standard Touch Calling Unit		
Low-Frequency Group L2 (770 Hz)	0.36 to 0.72 Vrms. (-5.9 ± 3 dBm)	0.22 to 0.44 Vrms (-10.1 ± 3 dBm)
High-frequency Group H2 (1,336 Hz)	0.43 to 0.85 Vrms (-4.4 ± 3 dBm)	0.25 to 0.51 Vrms (-8.9 ± 3 dBm)
Miniature Touch Calling Unit		
Low-Frequency Group L2 (770 Hz)	0.27 to 0.54 Vrms (-8.4 ± 3 dBm)	0.24 to 0.47 Vrms (-9.5 ± 3 dBm)
High-Frequency Group H2 (1,336 Hz)	0.37 to 0.73 Vrms (-5.7 ± 3 dBm)	0.31 to 0.62 Vrms (-7.1 ± 3 dBm)

Table 10. Single-Frequency Test.

PUSHBUTTON PAIRS	FREQUENCY (Hz)
1 + 2	697
4 + 5	770
7 + 8	852
* + 0	941
1 + 4	1,209
2 + 5	1,336
3 + 6	1,477