

CIRCUIT DESCRIPTION
TYPE 10A1 KEY TELEPHONE SYSTEMS

1. GENERAL

1.01 This section describes the operation of the individual circuit assemblies used in 10A1 key telephone systems, including some angle-bracket-mounted assemblies originally intended for use in the 10A system. Whenever possible, each assembly will be discussed separately in order to keep the information as widely applicable as possible. Since the variety of combinations of these assemblies is so great, the operation of combinations of assemblies will not be described except where necessary.

1.02 This revision is issued to add figures 11 through 14 and related text covering those 10A key telephone system assemblies still in manufacture which are sometimes associated with 10A1 systems. Figure 8 has been substantially revised to include modification of the A1-A3 relay spring numbering and references thereto, as well as to show changes in relays FA and FB, relocation of strap G, addition of strap Y and addition of F and G wiring. The same modification of relays FA and FB has been shown in figure 5, and the same addition of strap Y, F and G wiring in figure 1. Correction of lead destinations has been made in these and in other figures.

2. CENTRAL OFFICE OR PBX LINE
CIRCUIT (FIGURE 1, H-883002-2,
H-85781-1)

2.01 When the central office applies ringing potential to the line for a call to the station served by the key telephone system, relay R is energized over a path which varies, depending upon the strapping option selected in accordance with the ringing scheme used in the central office. As wired at the factory with G and X straps for metallic service, ringing current from the ring side of the line passes over the X strap, springs 3T-4T of relay A, capacitor C, diode MR5, thermistor R, the number 2 winding of relay R, and the G strap to the tip side of the line. If the system is installed at a ring station, the path from the ring side of the line is the same, over the X strap, but the return is to ground, either directly over the S strap or by way of the R strap and the common audible signal control (Fig. 7). These options can not be used with bridged ringing. If the system is installed at a tip station, the Y strap is used in substitution for the X strap, with either the R or the S strap, as before. In any case, relay R is energized in series with thermistor R during the negative half-cycle of the a-c wave. During the positive half-cycle, diode MR1 conducts, by-

passing relay R, while flow through diode MR5 is blocked, inserting resistor A in the path to avoid damage to the thermistor. Varistor MR3, which protects against the effects of line transients, is provided at the factory with G wiring. When R strapping is installed for the common audible signal option, G wiring should be disconnected and replaced with F wiring. Thermistor R has an initial high resistance which prevents relay R from operating on short stray pulses, but this resistance is greatly reduced by the heating effect of ringing current, thus permitting R to operate and apply ground over its contacts 4B-3B to lead TO. This energizes the heater winding of relay TO in the lamp flashing and incoming signal timeout circuit (figure 5), where the thermal contact requires about 30 seconds of heating before opening. Until then, relay R locks its number 1 winding over its contacts 2T-1T and relay A contacts 3B-4B to ground returned from the timeout circuit on lead LK. The ground applied to lead TO is also extended in figure 5 (via figure 6 when provided) to lead F, where it starts the lamp flashing circuit. This provides a periodic closure between leads LB and LF, so that the a-c supply for the line lamps is intermittently connected through relay R contacts 1B-2B to lead L, thus causing the lamps at all stations to light during each closure. Relay R also applies battery (or ringing potential) over its contacts 4T-3T to sound the buzzers (or ringers) which signal the incoming call.

2.02 To answer the call, the line pick-up key is depressed and the handset is lifted off-hook. Ground on lead A1 is closed through the called station's telephone (via the depressed line pick-up key) to lead A of this circuit, operating relay A. Operated, relay A at contacts 3B-4B opens the holding path for relay R, relay R releases, removing ground from lead TO and R1 opening the circuit to the lamp flashing and, the automatic time out circuit and the common audible signal equipment. Relay A at contacts 5B-6B closes ground to lead CO, operating relay TO in the lamp flashing and incoming signal time out circuit (figure 5, -9). In operating, relay TO removes battery from its heater winding. Relay A, at contacts 5T-6T closes the \pm lead of the visual signal power supply to lead L to light the line and busy lamps (of all key telephones accessing this circuit) steadily to indicate a busy line.

2.03 The call in progress can be placed in a hold condition by operating the hold key, which mechanically releases the line pick-up key. When

the line pick-up key restores, ground is removed from lead A, and the winding of relay A. Relay A restores, removing the shunts from both windings of relay H. Relay H operates, placing a 180 ohm loop across tip and ring to hold the preceding equipment operated. Operated, relay H at contacts 3-4, closes ground to lead HA, which holds relay TO of the line flashing and incoming signal time out circuit (figure 5, -9) operated, and also operates relay WS of the lamp winking circuit (figure 6, -10). Relay WS closes ground over lead S through make contacts of relay FB (figure 5, -9), to lead W, to operate relay W of the lamp winking circuit. Operation of the lamp winking circuit is discussed in paragraph 7. To release the call from a hold condition, depress the line pick-up key of the line on hold. Relay A re-operates and at contacts 1B-2B and 1T-2T places a shunt across windings #1 and #2 of relay H, respectively. Relay H restores and releases the lamp winking circuit.

2.04 An outgoing call is originated from a key telephone station by depressing the line pick-up key of an idle line (indicated by a dark line lamp) and removing the handset from the cradle. Operation of the line pick-up key extends ground from lead A1 through the key telephone to operate relay A over lead A. Operated, relay A shunts both windings of relay H at contacts 1T-2T and 1B-2B. Relay A, at contacts 5B-6B, closes ground to lead CO, to operate relay TO of the lamp flashing and incoming signal time out circuit (figure 5, -9). Relay A closes the \pm lead of the visual signal power supply through its contacts 5T-6T to lead L, to light the line and busy lamps of other key telephones on the same line, to indicate the line is busy. The calling party can proceed to dial.

3. AUTOMATIC TIE LINE CIRCUIT (FIGURE 2, H-883002-3, H-85781-2)

3.01 On an incoming call, battery applied to the tip side and ground applied to the ring side of the line by relay TB of the distant tie line circuit, is closed to leads T and R of this circuit, through relay RET, to the winding of relay L. Relay L operates and at contacts 1-2 closes ground through break contacts of relay CO and TB, to operate relay L1. Operated, relay L1 at contacts 1-2 closes ground via lead TO to the lamp flashing and incoming signal time out circuit (figure 5, -9) to the heater winding of relay TO, to start automatic time out. The same ground is extended to the winding of relay FB (through the lamp winking circuit if provided) to start the lamp flashing circuit (paragraph 6.01). Relay L1, at contacts 3-4, closes lead LF, interrupted at the lamp flashing circuit, to lead L, to signal the called station by flashing the corresponding line lamp. Relay L1, at contacts 5-6, closes lead RR to lead R of this circuit and also at

the common equipment circuit (figure 7, -11). Negative battery from the audible signal power supply is extended via lead -MB, \pm of the common equipment circuit, to leads R and R1, to start the common audible signal equipment. Relay L1, at contacts 7-8, closes the -MB, \pm lead (terminal 36) of the audible signal power supply to lead R1, to start the individual or common audible signal equipment.

3.02 When the called party answers, by lifting the handset from the cradle and depressing the line pick-up key, the T and R leads are bridged or looped through the called party's key telephone, closing ground to the winding #1 of relay TB. Relay TB operates, and releases relay L1. Relay L1, released, stops the automatic time out and lamp flashing circuits by removing ground from lead TO. Operated, relay TB at contacts 5B-6B, closes ground over lead CO to operate relay TO of the lamp flashing and incoming signal time out circuit (figure 5, -9) and at contacts 3B-4B closes ground to the winding of relay CO. Relay CO, operates and locks to ground at contacts 1-2 of relay L. Relay CO, at contacts 5-6, connects lead LB (\pm AC lead from visual signal power supply) to lead L to light the line and busy lamps associated with this line steadily, to indicate a busy line.

3.03 When the calling party releases first, restoring the TB relay of the distant tie line circuit, relay L of this circuit remains operated from battery and ground at contacts 1B-2B and 3T-4T of relay TB. Relay L, in turn, holds relay CO operated, to prevent a false incoming signal. Relay TB of this circuit restores when the called party releases, releasing relay L, which in turn releases relay CO, returning this circuit to normal. If the called party releases first, relay L holds operated from battery and ground over leads T and R from the distant tie line circuit. Relay L holds relay CO operated to prevent a false incoming signal. Relay L will remain locked operated until the calling party at the distant tie line station releases, restoring the TB relay of the distant tie line circuit, thus removing battery and ground from leads T and R. Released, relay TB releases relay CO, returning this circuit to normal.

3.04 Lifting the handset at the key telephone station and depressing the line pick-up key, when the line is idle (indicated by dark busy lamps), closes a loop circuit through the telephone over leads T and R to the windings of relay TB. Relay TB operates and at contacts 1B-2B and 3T-4T, closes ground and battery to the winding of relay L. This battery and ground is also applied to the T and R leads through the windings of relay RET to the distant tie line circuit to signal the called station. Relay operation at the distant tie line circuit is the same as described in paragraph 3.01.

4. RINGDOWN TIE LINE CIRCUIT (FIGURE 3, H-883002-4, H-85781-3)

4.01 During an incoming call, ringing current over leads T and R from distant ringdown tie line circuit operates relay R. Relay R, at contacts 5-6, closes lead R to lead RR and at contacts 2-3, closes battery to the winding of relay R1. If a common audible signal control is provided, closing lead R to lead RR, will start the common audible signal. Relay R1 operated, locks to battery at lead LK from the automatic time out circuit (figure 5, -9). The battery will remain on lead LK until the bi-metallic contacts of the thermal relay TO (figure 5, 9) open. Relay R1 at contacts 3-4 closes ground to lead TO and the heater winding of the thermal relay of the automatic time out circuit; ground at 3-4 is also closed to relay FB of the lamp flashing circuit (figure 5, -9), starting the lamp flashing circuit. Relay R1 at contacts 5-6, closes leads LF to lead L. Lead LF has interrupted battery closed to it from lead LB of this circuit, through contacts of relay FB of the lamp flashing circuit, causing the line lamps to flash, indicating an incoming call. Relay R1 at contacts 7-8, closes lead -MB, \pm to lead R1. This connects negative battery from the audible signal power supply to the individual or common audible signals.

4.02 The called party answers by taking the handset off-hook and depressing the corresponding line pick-up key, indicated by a flashing lamp. A loop is completed through the key telephone, from battery at the winding #1 of relay TB over lead R, through the key telephone over lead T to ground at the winding #2 of relay TB. Relay TB operates. Relay TB at contacts 1T-2T opens the holding path to relay R1. Relay R1 releases, stopping lamp flashing and audible signaling. Relay TB at contacts 5B-6B, transfers lead LB to lead L, to light the line lamps steadily, to indicate a busy line. Relay TB at contacts 3T-4T closes ground over lead CO to the TO relay of the automatic time out circuit (figure 5, -9). Relay TO operates and removes battery from the heater winding of the thermal relay. Relay TB at contacts 3B-4B and 1B-2B, completes the transmission path.

4.03 To originate a call from a key telephone station, lift the handset off-hook and depress the corresponding line pick-up key and the signal key. Depressing the line pick-up key completes a loop from battery at winding #1 of relay TB over lead R, through the key telephone, over lead R to ground at winding #2 of relay TB. Relay TB operates and at contacts 5B-6B closes leads LB to lead L, to light the line lamps steadily, to indicate a busy line. Depressing the signal key, closes ground over lead S to the winding of relay RO. Relay RO operates and at contact 2-3 and 5-6 closes ringing current over leads T and R to the distant tie line circuit. When the

signal key is released, ground is removed from lead S, releasing relay RO. Released relay RO, extends the calling key telephone station to the called station.

4.04 During transmission, the TB relays of both tie line circuits are held operated across the T and R leads by station equipment. When either the called or calling party disconnects, opening the loop across the T and R leads, their associated TB relays release, returning the tie line circuits to normal.

5. STATION LINE CIRCUIT (FIGURE 4, H-883002-5, H-85781-4)

5.01 When the calling party, at the distant station, lifts the handset off-hook, a loop is completed from ground at winding #2 of relay L through contacts 1-2 of relay RO, through the loop at the calling station, through contacts 4-5 of relay RO, to winding #1 of relay L and battery. Relay L is energized and operates. Relay L, at contacts 1-2, closes ground through break contacts 1-2 of relay CO, break contacts 1-2 of relay TB, to the winding of relay L1. Relay L1 operates and at contacts 1-2 closes ground through lead TO to the heater winding of the thermal relay (figure 5, -9), to start the time out circuit, this same ground is closed to relay FB of the lamp flashing circuit (figure 5, -9). Relay L1 closes lead LF, which is connected to lead LB (lamp battery) of this circuit through make contacts of relay FB (figure 5, -9), to lead L, causing lamp flashing at all stations accessing this circuit. Relay L1 at contacts 7-8, closes negative battery from lead -MF, \pm through lead R1, to the ringers of all stations accessing this circuit.

5.02 When the called station answers, by lifting the handset off-hook and depressing the line pick-up key, a loop is completed from ground at winding #2 of relay TB, through the loop at the called station, to winding #1 of relay TB and battery. Relay TB is energized and operates. Relay TB at contacts 1-2 opens the circuit to the winding of relay L1, causing relay L1 to release and stop all signaling. Relay TB at contacts 5-6, closes ground through lead CO to relay TO of the automatic time out circuit (figure 5, -9). Relay TO operates, removing battery from the heater winding, stopping the time out. Relay TB, at contacts 3-4, closes ground to the winding of relay CO. Relay CO is energized and operates. Relay CO, at contacts 5-6, closes lead LB to lead L, to light the station line lamps steadily to indicate a busy line. The two parties can now converse.

5.03 Lifting the handset off-hook and depressing the line pick-up key at the key telephone station completes a loop from ground at winding #2 of relay TB, through the loop at the key telephone

station, to battery at winding #1 of relay TB. Relay TB operates, and at contacts 3-4 closes ground to the winding of relay CO. Relay CO is energized and operates. Relay CO at contacts 5-6 closes lead LB to lead L, to light the corresponding line lamps steadily, indicating a busy line.

5.04 Depressing the signal key at the key telephone station closes ground through lead S to the winding of relay RO. Relay RO is energized and operates. Relay RO at contacts 2-3, and contacts 5-6, closes ringing current to the distant station. When the signal key is released, ground is removed from lead S, de-energizing relay RO. Relay RO releases and removes ringing current from the line. When the distant station answers, by lifting the handset off-hook, a loop is completed from ground at winding #2 of relay L, through contacts 1-2 of relay RO, through the loop at the distant station, through contacts 5-6 of relay RO, to winding #1 of relay L and battery. Relay L is energized and operates. Relay L at contacts 1-2 closes ground to relay CO, to prevent false signaling should the calling key telephone station hang up first.

5.05 During conversation, relays L, TB, CO, remain operated. Should the party at the distant station disconnect first, the loop is opened to relay L, and relay L restores. Relay TB and CO remain operated. When the key telephone station disconnects, the loop to relay TB is opened. Relay TB releases, and at contacts 3-4 opens the holding circuit to relay CO; relay CO restores, returning this circuit to normal. Should the key telephone disconnect first, the loop to relay TB is opened; relay TB restores. Relays L and CO remain operated. When the distant station disconnects, the loop is opened to relay L. Relay L restores and at contacts 1-2 opens the holding path to relay CO, relay CO restores, returning this circuit to normal.

6. LAMP FLASHING AND INCOMING SIGNAL TIME OUT CIRCUIT (FIGURE 5, H-883002-9, H-85781-5)

6.01 On incoming calls, ground on lead F (from -2, -3, -4, or -5; figures 1, 2, 3, or 4, respectively) is closed through break contacts 2T-3T of relay FA, to the winding of relay FB. Relay FB is energized and operates. Relay FB, at contacts 7T-8T, closes ground to the winding of relay FA. Relay FA is energized and operates. Relay FA, at contacts 2T-3T, opens the operating circuit to relay FB, relay FB is de-energized and releases. Relay FB in restoring, opens its make contacts 7T-8T, removing ground from the winding of relay FA. Relay FA is de-energized and restores, reclosing ground to the winding of relay FB. This cycle will continue as long as ground remains on lead F.

6.02 On incoming calls, ground on lead TO (from -2, -3, -4, or -5; figures 1, 2, 3, or 4, respectively) is closed to the heater winding of the thermal relay. The heater winding will generate enough heat in about 30 seconds to cause the bimetallic springs to open. Ground on lead CO is closed to the winding of relay TO; relay TO is energized and operates. Operated, relay TO, at break contacts 1T-2T, removes battery from the heater winding, stopping the time out circuit.

6.03 Ground on lead CO, from the central office or P-B-X line circuit, is closed to winding #1 of relay TO. Relay TO is energized and operates. Relay TO, at contacts 3T-4T, closes battery to the winding of relay PF1, and at contacts 5T-6T closes battery to the winding of relay PF2. Relay PF1 and PF2 operate and remove the shunt across the R and R1, and T and T1 leads of the central office or P-B-X line circuit. Should a power failure occur, relays PF1 and PF2 will restore. Contacts of relay PF1 and PF2 provide an alternate path that bridges the central office or P-B-X line circuit (figure 1, -2). In this way, when relay A of the central office or P-B-X line circuit cannot operate because of power failure, the central office or P-B-X line is connected directly to the key telephone station, and outgoing calls can always be made. Incoming calls can be received if bridged ringers are provided.

7. LAMP WINKING CIRCUIT (FIGURE 6, H-883002-10, H-85781-6)

7.01 When relay H of the central office or P-B-X line circuit operates during a hold condition, ground at make contacts 3-4 is closed through lead HA, through the lamp flashing and incoming signal time out circuit (figure 5, -9), to the winding of relay WS of this circuit. Relay WS is energized and operates. Relay WS, at contacts 2-3, closes ground through lead F to the winding of relay FB of the lamp flashing and incoming signal time out circuit. Relay FB operates and starts the lamp flashing circuit as discussed in paragraph 6.01. Relay WS, at contacts 4-5, closes ground through lead S, through a pair of make contacts on relay FB (figure 5, -9), through lead W, to the winding of relay W of this circuit. Relay W, at make contacts 6T-7T, closes this same ground to the winding of relay WT. Relay WT operates, and at contacts 4-5, opens the operating path to relay W. Relay W releases, and at contacts 6T-7T, opens the operating path to relay WT. Relay WT releases, and at contacts 4-5, recloses the operating path to relay W, reoperating relay W. This cycle will continue while ground remains on lead HA. When relay H of the central office P-B-X line circuit releases; ground on lead HA is removed, releasing relay WS.

8. COMMON EQUIPMENT CIRCUIT
(FIGURE 7, H-883002-11, H-85781-7)

8.01 When an intercom station lifts the handset off-hook and operates the intercom line button, a loop is completed from ground at winding #2 of relay BF, through the loop at the calling station, to battery at winding #1 of relay BF. Relay BF is energized and operates. Relay BF, at contacts 1-2, closes lead -MB from the visual signal power supply, to lead L, causing the intercom line lamps to light steadily. Relay BF, at contacts 3-4, closes ground to lead CO, to start the automatic time out circuit (-9).

8.02 Relay R1 operates in conjunction with the central office or P-B-X line circuit. Ringing current closed to lead ST through the central office or P-B-X line, causes relay R1 to operate. Relay R1, at contacts 3T-5T, closes lead -MB, ± lead R to start the common audible signal equipment.

9. THREE CENTRAL OFFICE OR P-B-X LINE CIRCUITS WITH LAMP FLASHING AND INCOMING SIGNAL TIME OUT CIRCUIT
(FIGURE 8, H-883002-12, H-85781-8)

9.01 This circuit consists of three central office or P-B-X line circuits and a lamp flashing and incoming signal time out circuit, all mounted on a single panel. Internal strapping provides a large amount of wiring which would be installer's wiring if separate, individually mounted, circuits were used. The operation of this circuit is the same as the combined operation of the separate circuits and can be followed by referring to paragraphs 2 and 6.

10. DIAL INTERCOM SELECTOR CIRCUIT
(FIGURE 9, H-883002-70, H-85973-1)

10.01 Seizure. Lifting of the handset at an intercom station telephone and operation of the intercom system push-button key at that telephone, when the intercom system is idle (busy lamps dark), closes a loop circuit through the telephone over the T and R leads to the windings of relay A to talking (A) battery and ground. Relay A operates, closes a circuit to relay B, and relay B operates after a brief delay due to its sleeve. Relay B, in operating, closes a circuit to light the busy lamps associated with the intercom system at all intercom stations. This also removes a ground from lead J, closes a ground to lead H, and completes a circuit from ground on terminal 20B (strap "L"), through strap "A", to the two windings of relay D in series, aiding, causing relay D to operate. Relay B also prepares a pulsing path to the rotary switch MM.

10.02 Dialing. As the calling party dials, opening and closing the loop, relay A follows the pulses, alternately restoring and reoperating; relay B is alternately energized and de-energized, but remains operated due to its sleeve. When relay A restores, a circuit is closed from ground through contacts of relay B and strap "D" to the motor magnet of the rotary switch MM. The rotary switch MM armature operates, but the wipers do not step at this time since this is an indirect drive switch. The interrupter contacts, however, do operate closing a circuit from the same ground, through rectifier MR1 and operated off-normal contacts 2 and 3, to the winding of relay T and relay C and, in parallel, to capacitor C1 through resistor R3 and operated contacts of relay D. Relay T operates, relay C also operates after a brief delay due to its heel-end slug, and closes a multiple holding ground from make contacts 2T and 3T of relay B to the winding of relay T. Relay C also completes a circuit to charge capacitor C2, and opens the signaling and group-selecting circuits. When relay A reoperates, relay B is re-energized, relay C is de-energized but holds due to its heel-end slug, and maintains a holding ground to relay T. Rotary switch MM is de-energized, allowing its armature to restore and move the wipers one rotary step. Relay A follows the remaining pulses of the digit dialed by the calling party. Rotary switch MM follows the pulses of relay A and steps its wipers to a position corresponding to the digit dialed.

10.03 Signaling. When dialing is completed, relay A remains operated, relay B is energized and stays operated as do relays D and T. Relay C is de-energized, but it is slow to release due to its slug. When relay C does restore, a circuit is closed from the audible signal power supply through contacts of operated relays D and T, contacts of relay C, restored to level A of the rotary switch and to the signaling lead (R) to the dialed station. Over this path, and a common return, the audible signal of the called station is operated. Relay C, restored, removes the holding ground from relay T and from capacitor C2; capacitor C2 discharges through the winding of relay T, holding relay T operated for a period of 1½ to 3 seconds. During this time, the called station is audibly signaled. When capacitor C2 has discharged sufficiently, relay T will restore, opening the signaling circuit to the called station. No further signaling will take place unless the calling station re-dials.

10.04 Homing. When relay T restores at the end of signaling, a ground is closed from terminal 14B (strap "C") to the rotary switch motor magnet MM through the interrupter and off-normal contacts; the rotary switch steps, self-interrupted, to its home position where its off-normal contacts operate and open the stepping (homing) circuit. This circuit is now back to the condition just preceding dialing.

10.05 Re-dialing. The calling party may re-dial the called number one or more times for additional 1½ to 3 seconds audible signaling periods.

10.06 Answer and talking. If the called party answers, both telephones are connected in parallel across the same talking (A) battery source and relay A. They can now converse without difficulty. Other stations may also listen and talk by raising their handsets and, if necessary, operating their intercom system push-button keys. The seven party or seven station limit for participants in one conversation is desirable to insure that there is adequate current and voltage for each station. During conversation, relays A, B, and D remain energized and operated.

10.07 Disconnect. When both (or all) parties disconnect, the loop to relay A is opened, and relay A restores. As during dialing, relay B holds, relays C and T, and switch magnet MM are energized and operate. After a sufficient delay, relay B restores; this de-energizes relays D, C, and the rotary switch motor magnet MM. When relay D restores, the rotary switch wipers step onto the first position, and relay C restores after a brief delay. No signaling takes place because relay D is restored and rotary position 1 on the switch is not used. When relay C restores, relay T is de-energized and since relay D has already restored and capacitor C2 is not connected, relay T will restore at once. When relay T restores, the rotary switch will home as before. When the rotary switch MM is in its home position, and all relays are restored and de-energized, this circuit is ready to handle another call.

11. TYPE 10A1 INTERCOM LINE FLASHING CONTROL CIRCUIT (FIGURE 10, H-883002-8, H-85780-3)

11.01 One line flashing control circuit is required for each station on a dial intercom system; this circuit is connected between the individual key telephone station equipment and the selector circuit (figure 9, - 70). On intercom calls, the line flashing control circuits of the called and calling lines both operate, but no others. A line flashing control circuit consists of two relays: L and LS. The line flashing control unit provides three line flashing control circuits.

11.02 When a call is originated at a station associated with a line flashing control circuit, the operation of the line pick-up key and lifting of the handset closes a circuit from ground on the A1 lead through the line pick-up key and the hold key (if provided) to the A lead and battery-connected relay L. Relay L operates, locks, and connects the calling station to the intercom selector circuit. Intercom selector action is described in paragraph 10.

11.03 When the intercom selector is stepped (under dial control) to the contacts associated with a called station having a line flashing control circuit, direct battery is connected to lead C of the called station's line flashing control circuit causing its LS relay to operate. When relay LS operates, it locks, starts the time out circuit and the flashing circuit (paragraph 6), and switches control of the line lamp at the called station to the flashing circuit. This causes the line lamp, at the called station only to flash to indicate a call waiting to be answered, and prepares an operating circuit for the associated relay L (of the called station).

11.04 If the called station answers, the L relay of its line flashing control circuit will operate from ground on the A1 lead through the line pick-up key and hold key (if provided) to the A lead and battery-connected relay L. Relay L will operate, lock, and connect the called station through to the selector and common talking circuit, and open the circuit of relay LS. Relay LS will restore, stopping the time and flashing circuits, and returning control of the called station line lamp to normal, so it will now be lighted steadily, not flashing.

11.05 When each station disconnects by having its handset replaced on the cradle and the hook-switch operated, or its dial intercom line pick-up key restored (by operation of another key), the circuit to the L relay of the line flashing control circuit associated with that station will be opened and the L relay will restore. This circuit will then be at normal. When both stations have disconnected, the dial intercom selector circuit will respond as explained in paragraph 10.

12. TYPE 10A INTERCOM SIGNAL CIRCUIT (FIGURE 11, H-883000-5, H-85776-3)

12.01 The intercom signal circuit controls manual (code) signaling on an intercom line equipped both for manual and for selective (dial) signaling. When the non-locking signal key at one of the stations is depressed after connection to the intercom line to place a call, ground applied to lead S operates relay S. Relay S closes the circuits to buzzers or ringers at stations on the line arranged for manual signaling. During selective signaling of other stations on the line, relay S does not operate.

13. TYPE 10A AUTOMATIC CUTOFF CIRCUIT (FIGURES 12 AND 13, H-883000-28, H-85776-23)

13.01 The automatic cutoff circuit controls the connection of the T and R (or E) leads to stations which can be cut off automatically from a line. It differs from the W.E.Co. 26B Key Telephone Unit in that it lacks a pair of break contacts between terminals 5 and 17, and a second pair between terminals 6 and 18.

13.02 As shown in figure 12, ground applied over lead H from a station which can cut off other stations operates relay CO, which opens the path of the T and R leads to all stations on the line, and removes battery from lead B to prevent operation of relays CT in the cut-through relay circuits for stations which can be cut off except when on the line.

13.03 As shown in figure 13, ground applied over lead CO from the flashing control circuit associated with a dial intercom line (when a station on that line originates a call) operates relay CO, which removes battery from all leads E. This prevents any station on the line other than the called station from operating its relay L (see figure 10) to access the line.

14. TYPE 10A CUT-THROUGH RELAY CIRCUIT (FIGURE 14, H-883000-31, H-85776-24)

14.01 The cut-through relay circuit initiates cutoff by applying ground over lead H to operate the automatic cutoff control circuit (in figure 12). When a station which can cut off other stations gains access to the line, relay CT operates from ground

on lead A1 returned over lead A from the calling station. At a group 1 station (H lead connected; J strapping) relay CT applies ground to lead H for cutoff, extends ground received over lead A in series with a diode to lead A of other cut-through circuits, and connects the T and R leads of the line to the calling station. At a group 2 station (H lead connected; K strapping) relay CT will operate only if battery is present on lead B from the cutoff circuit. It locks itself to battery over its contacts 3B-4B before opening the path to lead B at its contacts 2B-1B, in addition to performing the functions listed for a group 1 station. At a group 3 station (H lead not connected; K strapping) relay CT operates in the same manner as at a group 2 station, but does not operate the automatic cutoff control circuit. At a group 4 station this circuit is not used, and the station is connected directly to the automatic cutoff circuit. When a second station has joined a call and the first station wishes to disconnect, ground on lead A (terminal 3) from the second station is prevented from holding relay CT by the blocking action of the diode, so that CT restores as soon as the first station removes ground from lead A (terminal 9).

NOTES - Figure 1

1. If a -11 circuit is provided, connect the ST lead (R strap) to that circuit. When -11 circuit is not provided, strap terminal 26 to terminal 36 (S strap).
2. Only relay-operating battery (18- to 28-volt dc) is used in this circuit.
3. G and X straps (factory installed) for bridged ringing. S and X straps for ring party divided ringing. S and Y straps for tip party divided ringing. R and X, or R and Y straps for divided ringing with common audible signal (see Note 5).
4. Provide when winking hold circuit not used.
5. G wiring factory installed. Replace with F wiring when using R strap.
6. Issue numbers herein refer to circuit drawing H-85781. On issues 1 through 3, present F wiring option was standard. On issues 1 through 5, relay R was equipped with stop springs 1B, 4B, 1T, 4T. Present springs 1B, 3B, 1T, 4T were numbered 2B, 5B, 2T, 6T, respectively. On issues 1 through 6, relay A had no X contacts. Present springs 1B, 4B, 1T, 4T, 5T were numbered 5T, 2B, 3T, 2T, 3B, respectively. On issues 1 through 7, varistor MR4 was MR2. MR2 was not identified. Resistor 3 and diode MR5 were not provided, and capacitor C was connected directly to thermistor R.

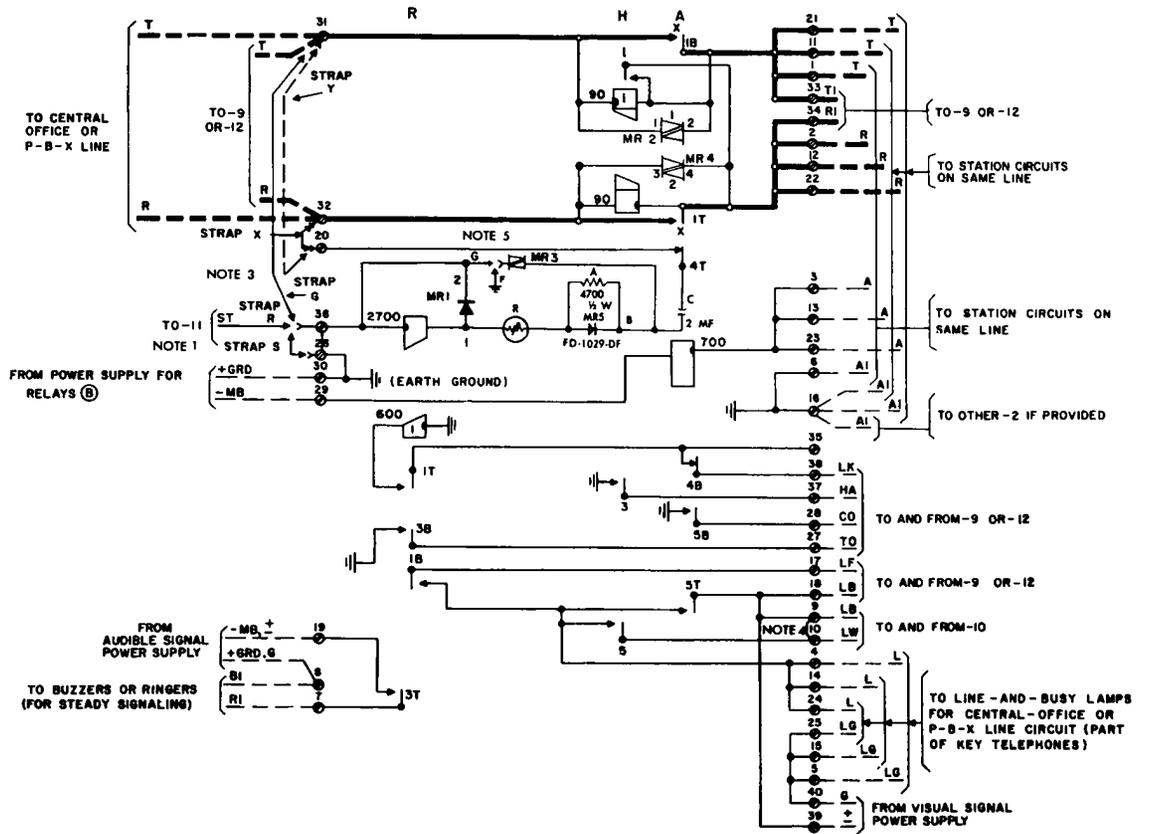


Figure 1. Central Office or P-B-X Line Circuit; H-883002-2, H-85781-1

NOTES - Figure 2

1. The 14- to 28-volt dc power input to this circuit (terminals 15 and 16), designated "A", is for transmission, and is connected only at the battery and ground connections marked "A"; the 18- to 28-volt dc power input (terminals 38 and 40), designated "B", is for relay operation and is connected to all battery and ground connection points except those marked "A".
2. The coil designated "RET", is a relay coil without any contact springs; it is used only for its impedance characteristics: as a retard coil is used. Its purpose is to isolate voice currents from the battery supply.

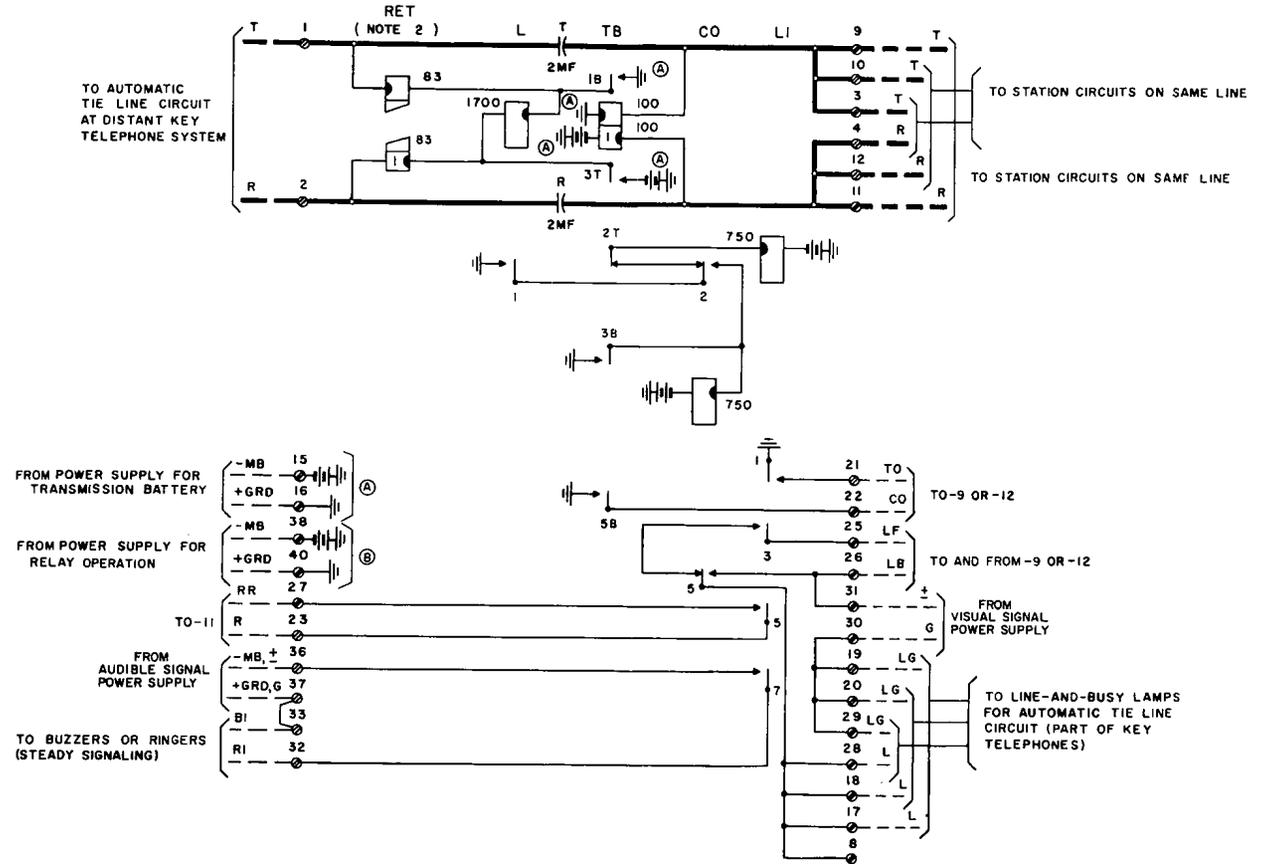


Figure 2. Automatic Tie Line Circuit, H-883002-3, H-85781-2

NOTES - Figure 3

1. Relay R in the ringdown tie line circuit has special stop springs.
2. The 14- to 28-volt dc power input to this circuit (terminals 15 and 16), designated "A", is for transmission and is connected only to the battery and ground terminals marked "A". The 18- to 28-volt dc power input (terminals 38 and 40), designated "B", is for relay operation and is connected to all battery and ground connection points except those marked "A".

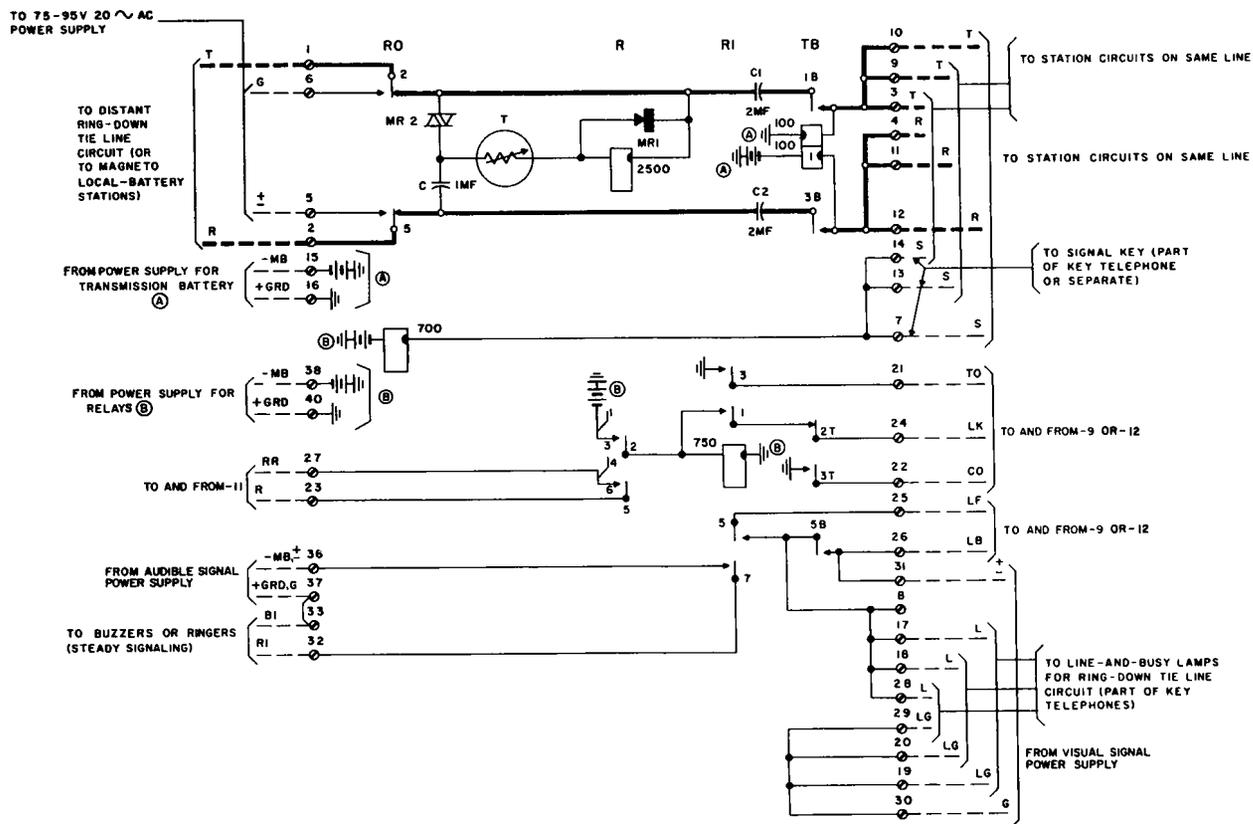


Figure 3. Ringdown Tie Line Circuit: H-883002-4, H-85781-3

NOTE - Figure 4

The 14- to 28-volt dc power input to this circuit (terminals 15 and 16), designated "A", is for transmission and is connected only to the battery and ground terminals marked "A". The 18- to 28-volt dc power input (terminals 38 and 40), designated "B", is for relay operation and is connected to all battery and ground connection points except those marked "A".

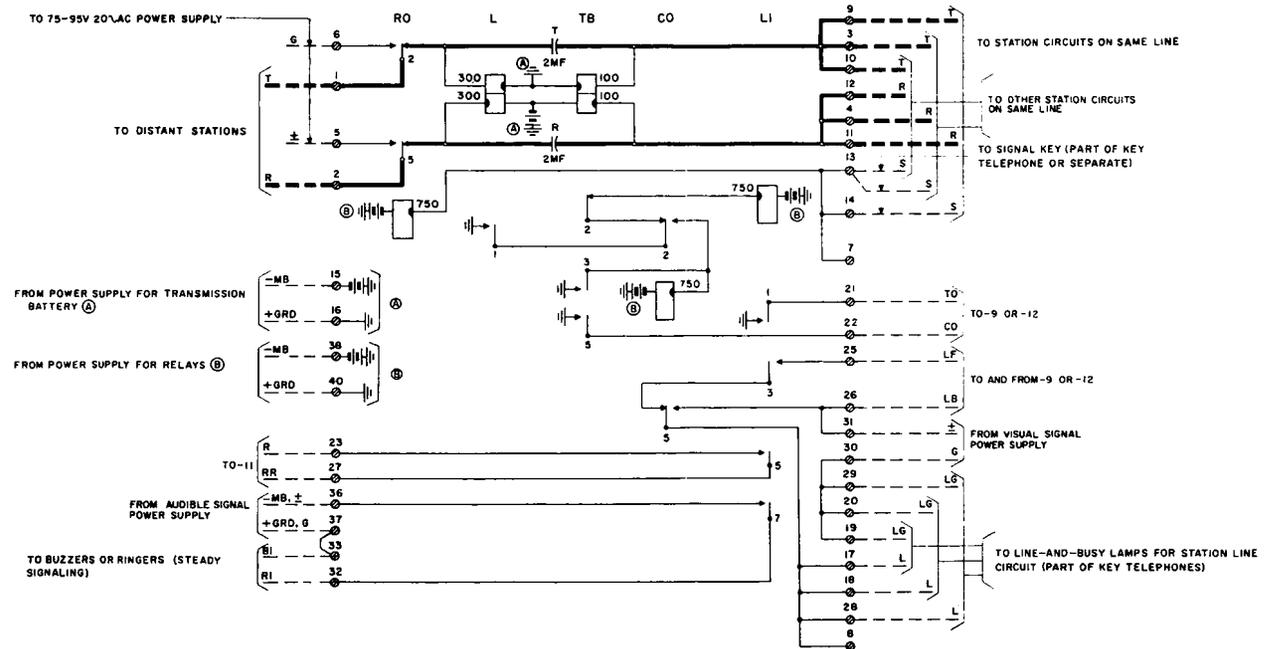


Figure 4. Station Line Circuit: H-9830/2-5, 11 85751-4

NOTES - Figure 5

1. The thermal relay of the automatic time out circuit is mounted in the left spring pile-up of relay TO, and springs 3B and 4B are operated by the thermal relay only.
 2. This circuit uses only relay-operating power (18- to 28-volt dc "B"); no transmission battery is required.
 3. Provide when winking hold circuit is not used.
- A. On issues 1 through 3 of circuit drawing H-85781, relays FA and FB were equipped with slow-to-release sleeved coils of 275Ω resistance, and diode J was not provided. For reference purposes, this former equipment is elsewhere designated as H apparatus, and the superseding equipment shown here, as J apparatus.

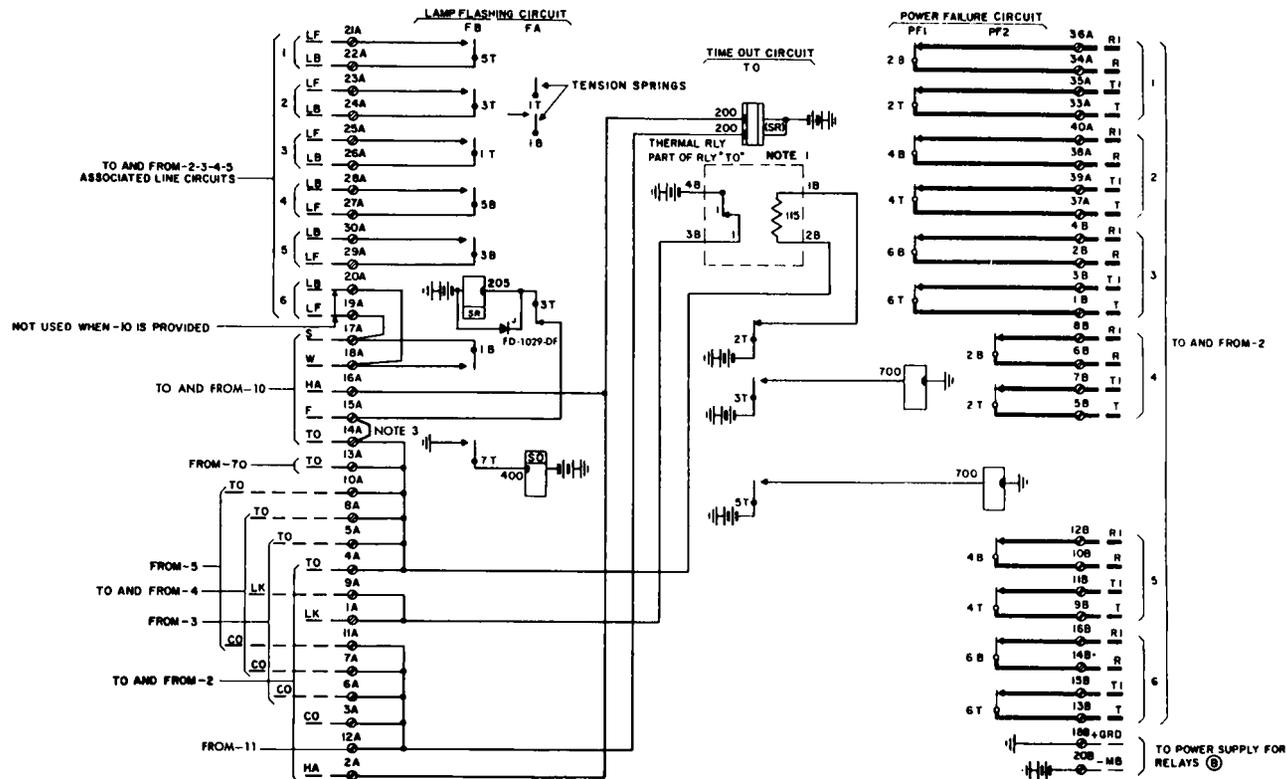
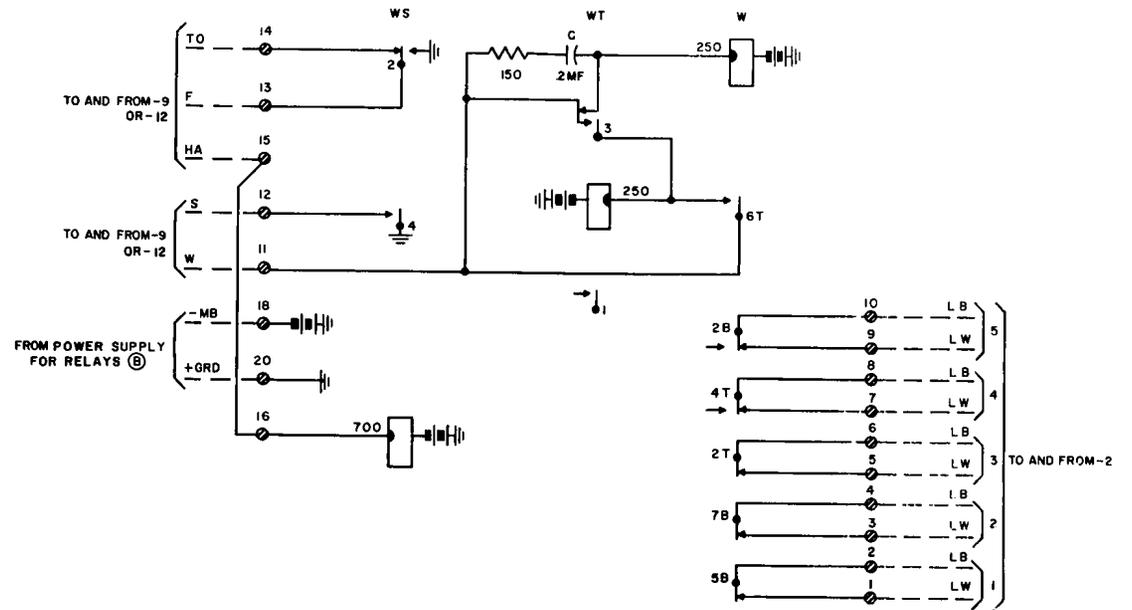


Figure 5. Lamp Flashing and Incoming Signal Time Out Circuit, H-883002-9, H-85781-5

NOTE - Figure 6

This circuit uses only relay-operating battery (18- to 28-volt dc); no transmission battery is required.



SEE ADDENDUM

Figure 6. Lamp Winking Circuit; H-883002-10, H-88781-6

NOTES - Figure 7

1. Relay R1 in the common equipment circuit is a special sensitive relay with micrometer adjustments.
2. The 14- to 28-volt dc power input to this circuit (terminals 38 and 40), designated "A", is for transmission and is connected only to the battery and ground terminals marked "A". The 18- to 28-volt dc ground only (terminal 37), designated "B", is for relay operation and is connected to all ground connection points except those marked "A".
3. Installer should add strap "E" 1 hour after dc power is connected to this unit.

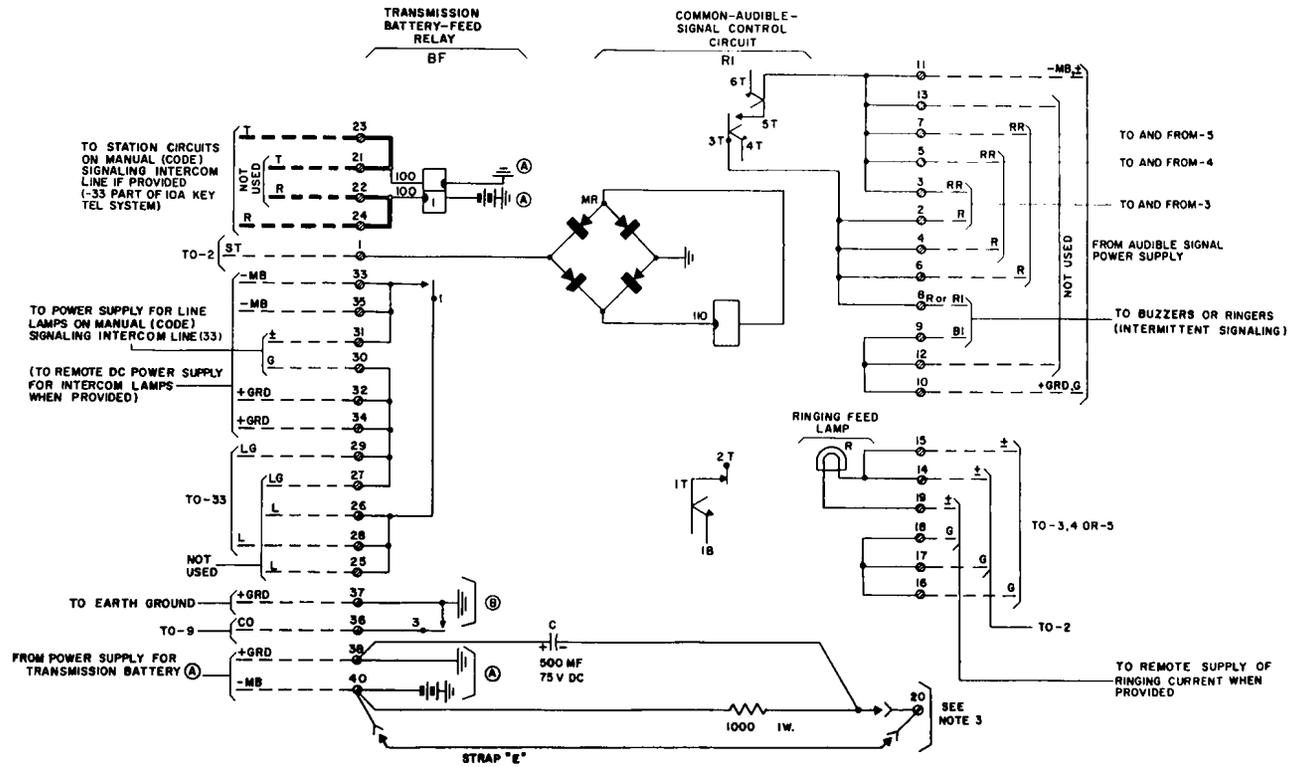
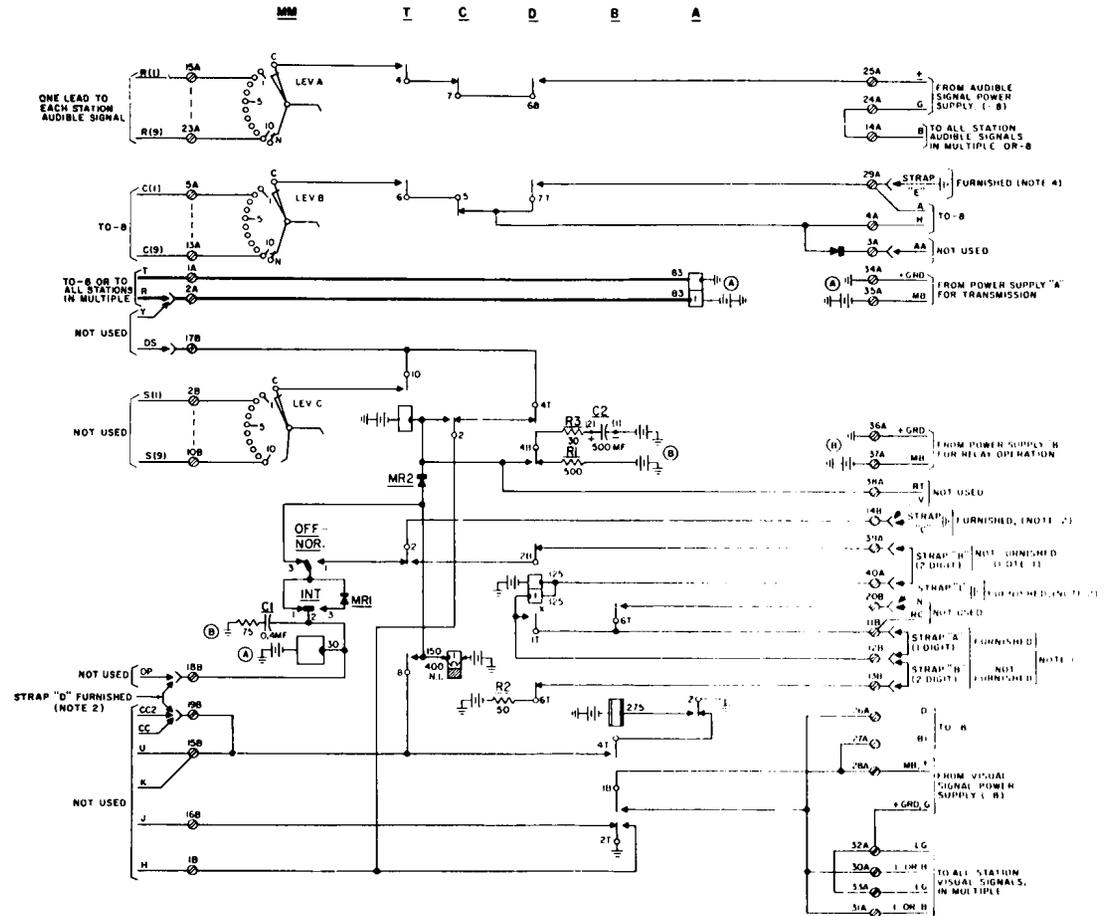


Figure 7. Common Equipment Circuit;
H-#3002-11, H-85781-7

NOTES - Figure 9

1. Strap "A", for one-digit operation, is furnished installed; for two-digit operation, omit strap "A" and use "B" straps (2).
2. Straps "C", "D", and "L", for operation of the selector without either talking link, are furnished; remove and connect alternate leads indicated when either private talking link circuit (-14 or -22) is used.
3. Lead CC2 is used only when the two talking link circuit (-22) and the audible signal and tone control circuit (-27) are both used. Lead CC is used with either private talking link circuit (-14 or -22), if -27 is not used.
4. Strap "E" is furnished installed, and is always used with 16A systems.
5. Relay D will not operate with both windings energized in parallel, opposing. Relay D will close its "X" contacts, due to inductive effect, when ground energizing both windings in parallel opposing is removed; relay D will operate and lock.
6. Diode MR2, and capacitor C2, make relay T slow to release.
7. Lead DS is used only with two-digit dialing (and either link circuit).
8. Resistor R4 must be removed, and strap "W" added when this circuit is used with -25.



SEE ADDENDUM

Figure 9. Selector Circuit Type 16A; H-883002-70, H-85973-1

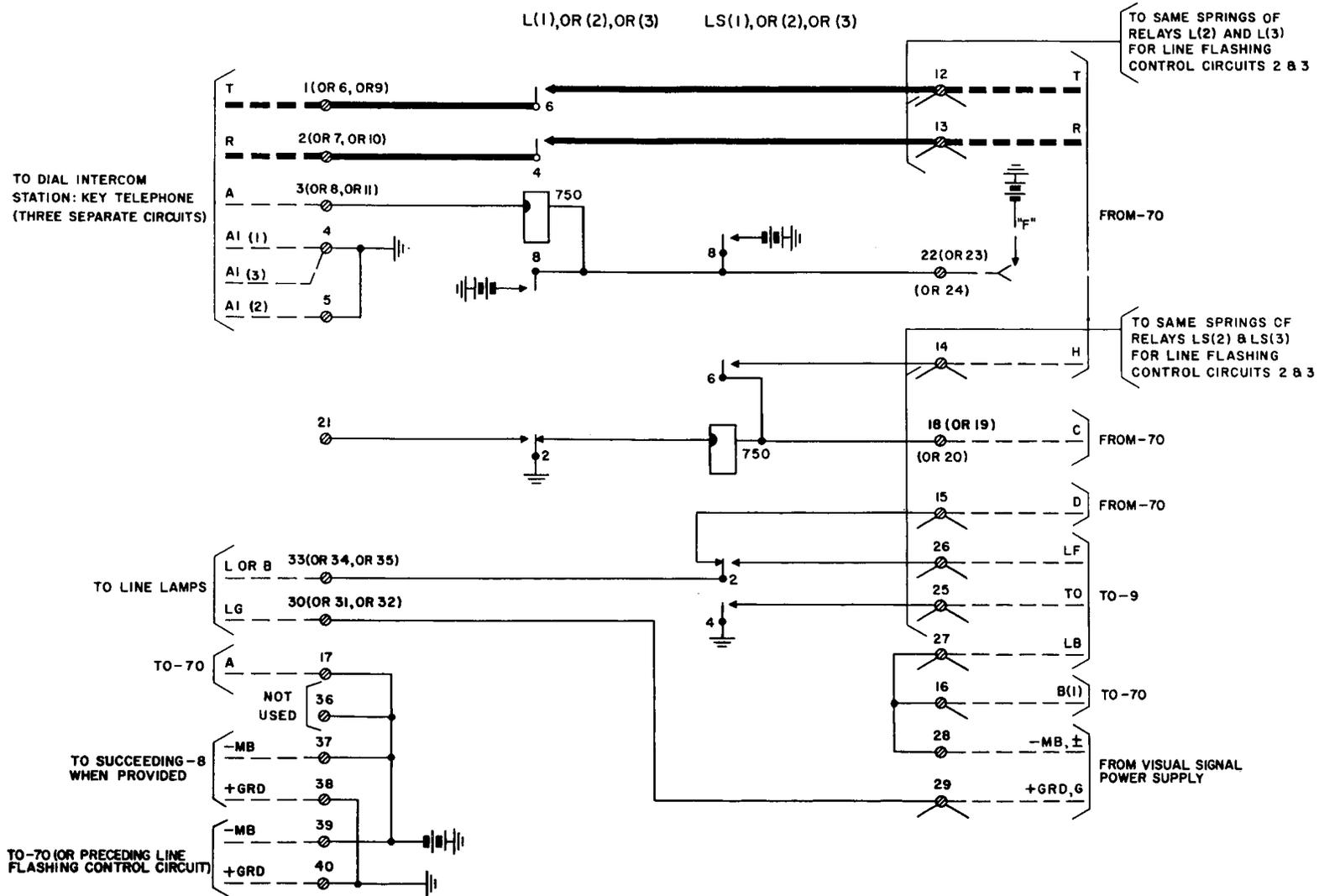


Figure 10. Dial Intercom Lamp Flashing Control Circuit; H-883002-8, H-85780-3

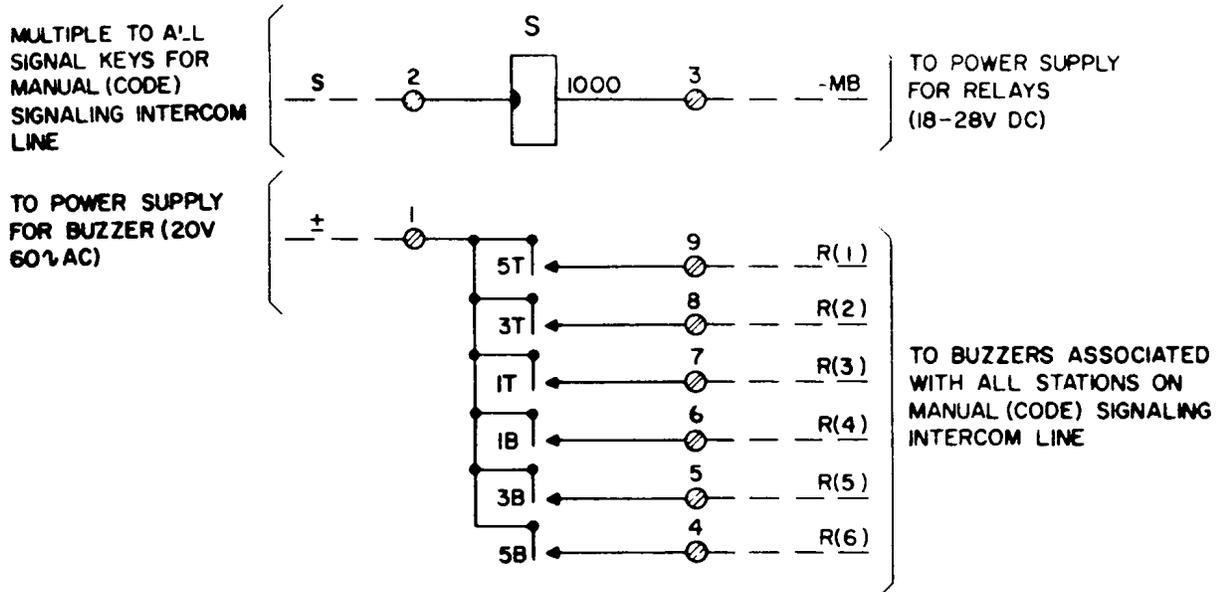


Figure 11. Intercom signal circuit; H-883000-5, H-85776-3

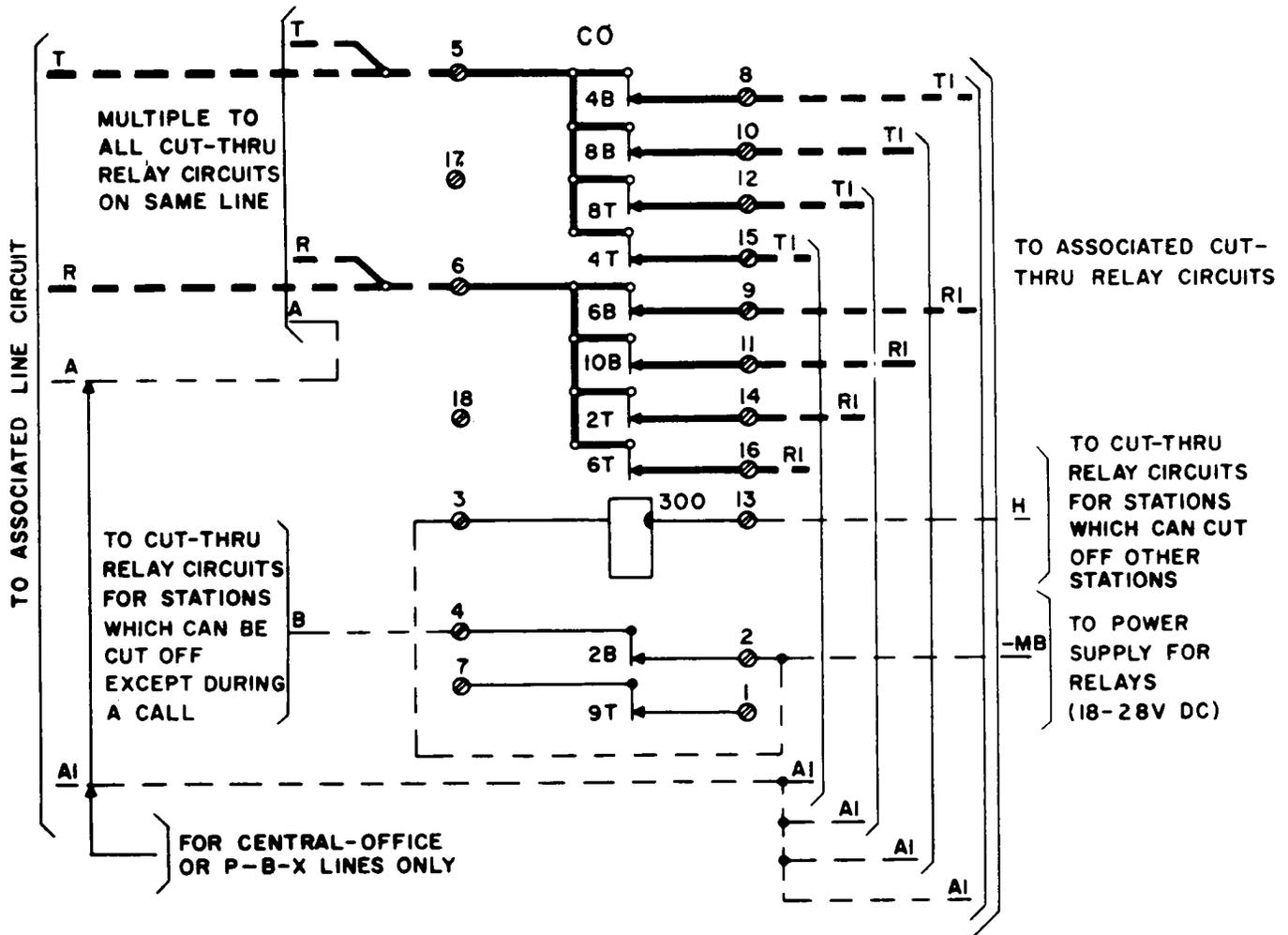


Figure 12. Automatic cut-off circuit; H-883000-28, H-85776-23

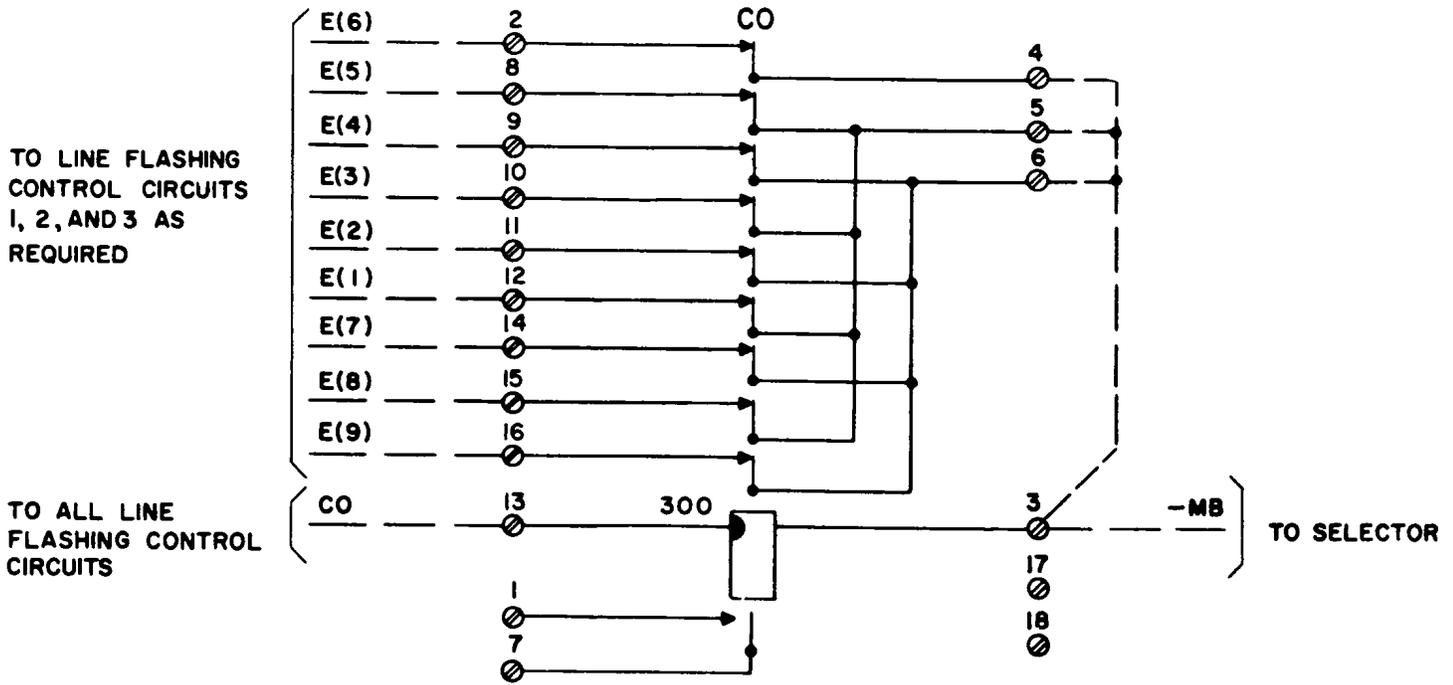


Figure 13. Secret service automatic cut-off circuit; H-883000-28, H-85776-23

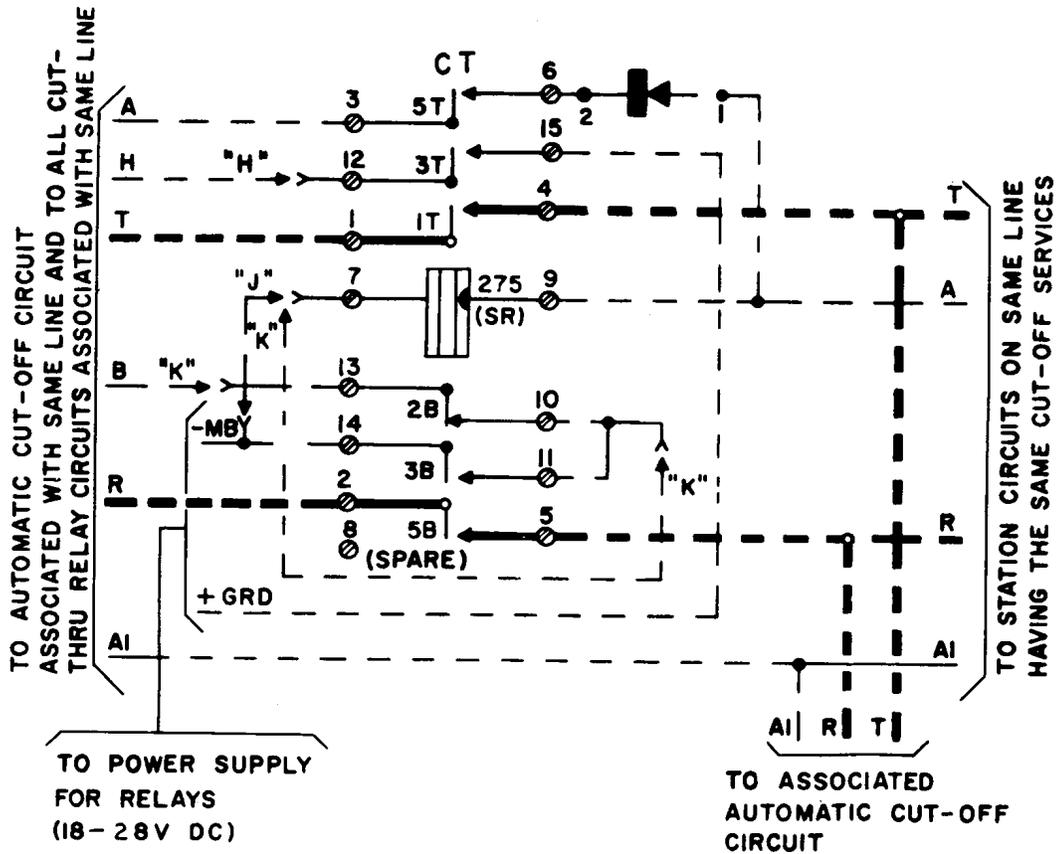


Figure 14. Cut-through relay circuit; H-883000-31, H-85776-24

CIRCUIT DESCRIPTION
TYPE 10A1 KEY TELEPHONE SYSTEMS

1. GENERAL

1.01 This addendum is reissued for correcting Paragraph 2.03 and Figure 6 of Section 484-400-400, Issue 2.

1.02 In ink or red pencil make the changes indicated in Part 2 to the figures and text of Section 484-400-400, Issue 2. Addendum Issue 3 is hereby cancelled, and the information contained within is incorporated in this issue. Remove and destroy Addendum Issue 3 from the practices binder and file Addendum Issue 4 ahead of Section 484-400-400, Issue 2.

1.03 Those changes that were not part of Addendum Issue 3 are indicated in Part 2 with marginal arrows.

2. CHANGES

2.01 In Figure 8, cross out the relay spring designation 5T appearing for relays A1, A2, A3 in the tip side of the conversation path, and enter the designation 1B in its place.

2.02 Similarly, in the ring side of the conversation path, cross out the A1, A2, A3 relay spring designation 3T and substitute the designation 1T. Adjacent to the two corrections enter the notation, "See Addendum".

2.03 The source (AECo drawing number) of each figure is given in its title. For more ready reference the issue number of the source drawing used for each figure is listed in Table 1. Note that the issue numbers apply to the figures as printed; changes made by addendum are related to drawing issue changes in the text of the addendum, but not in the table.

2.04 Except for those of early manufacture, the mounting plate of each key telephone unit is stamped with its circuit and equipment drawing numbers. Thus, the key telephone unit represented by Figure 4 (Station Line Circuit) will be marked 8H-85781-4, to denote Issue 8 of circuit drawing H-85781, Figure 4.

2.05 On Issues 1 through 10 of Dial Intercom Selector Circuit H-85973, as shown in Figure

9 of Section 484-400-400, Issue 2, the winding of relay C was connected to battery bus B, as fed from relay power supply B over terminal 37A. With the switch normal, this placed the unfiltered B battery supply in parallel with the filtered A battery supply (fed from terminal 35A for transmission) by way of a path including the coil of relay C, off-normal springs 3 and 2, interrupter springs 1 and 2, and the motor magnet of the rotary switch. The resulting crossfeed caused noise in the transmission path under certain conditions and was a hindrance to trouble analysis in cases where one battery supply blew a fuse, but not the other.

2.06 Beginning with H-85973 Issue 11, battery feed to the winding of relay C has been transferred to the A battery supply. To indicate this change in Figure 9, add an encircled A adjacent to the battery symbol at the C relay coil. In the margin below the coil symbol, enter the notation "See Addendum". To make this change in the wiring of selector circuit H-85973 Issues 1 through 10, disconnect the B battery bus from the winding of relay C, and connect the winding to the A battery source at terminal 35A.

2.07 The notation "not used", appearing adjacent to bracketed leads at the edge of Figure 9, applies only to the particular application of the circuit described in the text. The affected leads are used in other applications of the circuit, some of which include 10A1 system installation.

Table 1. Figure Sources.

Fig. No.	AECo Circuit Dwg. No.	Issue No.
1-3	H-85781	8
9	H-85973	10
10	H-85780	3
12-14	H-85776	8

NOTE: Strap Y, shown in Figures 1 and 3, does not appear on H-85781.

2.08 In the margin adjacent to Figure 6 write "See Addendum" and make the following changes:

- (a) Contact tied to terminal 14 should be 3.

- (b) Contact tied to terminal 13 should be 4.
- (c) Contact tied to ground and associated with above contacts should be 5.
- (d) Contact tied to terminal 12 should be 2.
- (e) Contact tied to ground and associated with 2 should be 1.

2.09 In the margin adjacent to Paragraph 2.03 write "See Addendum" and cross out Paragraph 2.03. The revised Paragraph 2.03 should read as follows:

2.03 The call in progress can be placed in a hold condition by operating the hold key. When the hold key is depressed ground is removed from Lead A and the winding of Relay A. Relay A restores, removing the shunts from both windings of Relay H. Relay H operates initially from the line battery on the ring side of the line, the 90 ohm #2 winding, ring and tip of the telephone circuit, 90 ohm, #1 winding to the tip side of the line. Relay H locks through contacts 1 and 2, placing a 180 ohm short across the tip and ring to hold the Central Office Equipment. When the hold key is released it mechanically releases the line pick

up key. Operated Relay H at contacts 3-4, closes ground to lead HA, which holds Relay TO of the line flashing and incoming signal time out circuit (Figures 5-9) operated, and also operates Relay WS of the lamp winking circuit (Figures 6-10). Relay WS closes ground over Lead S through make contacts of Relay FB (Figures 5-9), to Lead W, to operate Relay W of the lamp winking circuit. Operation of the lamp winking circuit is discussed in Paragraph 7. To release the call from a hold condition, depress the line pickup key of the line on hold. Relay A reoperates and at contacts 1B-2B and 1T-2T places a shunt across windings #1 and #2 of Relay H, respectively. Relay H restores and releases the lamp winking circuit.

2.10 In the margin adjacent to Paragraph 10.02 write "See Addendum". Change the sentence reading: "The interrupter contacts, however, do operate closing a circuit from the same ground, through rectifier MR1 and operated off-normal contacts 2 and 3, to the winding of Relay T and Relay C and in parallel to capacitor C1 through resistor R3 and operated contacts of Relay D". to read: The interrupter contacts, however, do operate closing a circuit from the same ground, through rectifier MR1 and operated off-normal contacts 2 and 3, to the winding of Relay T and Relay C and in parallel to capacitor C2 through resistor R3 and operated contacts of Relay D.