

## CIRCUIT DESCRIPTION

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APPENDIX 1D  
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5

STATION SYSTEMS  
4-WIRE SUBSCRIBER LINE CIRCUITS  
ARRANGED FOR COMMON  
BATTERY OPERATION

## CHANGES

A. Changed and Added Functions

- A.1 Association with circuits providing a dc continuity checking feature.

B. Changes in ApparatusB.1 SUPERSEDED SUPERSEDED BY

243B KTU, App Fig. 6      243C KTU, App Fig. 8

D. Description of Changes

- D.1 Option A is designated, rated AT&TCo Std, and added to FS9.
- D.2 Option B is designated, rated AT&TCo Std, and added to FS1.
- D.3 In FS6 the designation of installer straps is added for clarity.
- D.4 App Fig. 6 is rated Mfr Disc. and is replaced by App Fig. 8 which is designated, rated AT&TCo Std, and added to FS9.
- D.5 Circuit Note 102 is changed.
- D.6 Equipment Note 201 is added.
- D.7 Information Notes 302 and 303 are changed.

F. Changes in CD Sections

- F.1 Under SECTION II, change heading of 1.09 to read:  
243B KTU (Mfr Disc.) or 243C KTU

- F.2 Under SECTION II, change the first sentence of 1.10 to read:

In FS9, the shunt paths consist of  
(a) resistor TK, when A option is furnished,  
(b) the A capacitor and L, M, and T resistors in the shunt leg of the transmitting pad, and (c) the ST sidetone network (7 option) or the ST and SR capacitors and resistors of the sidetone bridge (G option).

- F.3 Under SECTION II, add:

DC CONTINUITY CHECK (OPTION A OR B)

1.22 Resistors TK and RK provide a high resistance closure of the line when associated with a circuit having a continuity checking feature. The resistors provide a negligible shunt to the transmission path, while resistor TK is removed during rotary dialing to prevent pulse distortion.

- F.5 Under SECTION III, 4, add:

(m) Private Service Systems - Switching System No. 304, 4-Wire Station Line Circuit - SD-1G165-01.

(n) PBX Systems - No. 758C Preemption and Continuity Test Circuit - SD-67054-01.

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DEPT 5324-RHM-GAP

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STATION SYSTEMS  
4-WIRE SUBSCRIBER LINE CIRCUITS  
ARRANGED FOR COMMON  
BATTERY OPERATIONSECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 This circuit provides means for signaling a subscriber station on a 4-wire common battery line from a central office or PBX, for holding the line, and for indicating by visual signals whenever the line is held or busy. It provides pickup relays and the common circuits necessary for the proper functioning of lines for a key telephone system. It also provides a manual exclusion circuit for a 4-wire line.

SECTION II - DETAILED DESCRIPTION1. DESCRIPTION OF OPERATIONINCOMING CALLA. Signaling

1.01 When ringing current is applied to the ring R1 of the receiving pair of the 4-wire line on an incoming call, the ac component flows through the secondary of relay R, thermistor R, capacitor R, and resistor R to the tip T of the receiving pair on one-half of the cycle, and through diode R, thermistor R, and capacitor R to the tip T on the other half cycle. The 317A varistor R1 protects diode R and thermistor R from transient currents. Resistor R protects the R varistor from damage by surge currents. The thermistor has a cold resistance in the order of 50,000 ohms which prevents relay R from operating when ringing current is first applied, preventing false operation on disconnect or other transients. Power absorbed from the ringing current increases the temperature of the thermistor and reduces its resistance to the order of 3000 ohms in about 1/2 second, permitting sufficient current to flow to operate the R relay on the half-wave rectified current due to diode R. Relay R locks operated on its primary winding under control of relay AH and the LK lead. Operation of relay R connects ground to the TO lead to start the time-out and lamp flashing functions in the Visual and Audible Signal Circuit, connects the signal lamp lead to the flashing circuit, and closes the CA or CAL lead to the common audible signal circuit and to the Auxiliary Service Transfer Circuit, if provided. When neither the common audible signal circuit nor the Auxiliary Service Transfer Circuit is provided, J wiring provides for directly controlling an audible signal.

B. Answering an Incoming Call

1.02 When an incoming call is answered, ground is placed on the A lead, operating the auxiliary pickup A-PU relay of FS4 associated with the line and the station. The A-PU pickup relay (a) places battery on the 4-wire class FW lead toward the key and telephone circuit; (b) in FS1 or FS9, closes the line side of repeating coil R; (c) connects the telephone receiver leads RT and RR to the station side of the repeating coil R; (d) connects the side-tone network between the transmitting pair and the receiving pair; (e) in FS4 connects ground to the A2 lead operating the A relay of the line circuit; (f) in FS2, extends the P4 lead to the ON relay for rotary dial systems (4 or 6 option) or for TOUCH-TONE dial systems, extends the SP lead to the Auxiliary Service Transfer Circuit (V option); (g) in FS3, extends the operating path of the exclusion A-EX relay (3 option) over the ET lead; (h) in FS7, extends a signal S lead to the D or E lead of the Auxiliary Service Transfer Circuit, if provided; and (i) in FS8, extends a second S lead to the second D or E lead of the Auxiliary Service Transfer Circuit, if provided.

1.03 In FS4, operation of the A relay in the line circuit performs the following functions:

- (a) In FS5, operates the auxiliary hold AH relay.
- (b) In FS6, transfers the lamp L lead from flashing battery to steady battery.
- (c) In FS1 or FS9, opens the operating path of the hold H relay, preventing it from operating falsely.

1.04 In FS5, operation of the AH relay (a) prepares a circuit from the LW lead to the L lead in FS6; (b) grounds the CO lead to the Visual and Audible Signal Circuit (T option) or to the Auxiliary Service Transfer Circuit (S option), if provided; and (c) in FS1 or FS9 opens the locking path of the R relay, allowing it to release.

OUTGOING CALL

1.05 The relay sequence for an outgoing call is the same as for an incoming

call except that the R relay will be in a released condition. Dialing is accomplished over the transmitting pair.

### C. TOUCH-TONE Dialing (242A KTU)

1.06 Dial frequencies generated in the key telephone set are transmitted to the line via the T1 and R1 leads of FS1 and the transmitting pad composed of resistors A, B, E, F, L, M, and T and capacitor A.

### D. Rotary Dialing

#### (243A KTU) (Mfr Disc.)

1.07 Dial pulses generated in the key telephone set are transmitted to the line via the T and R leads of FS1 and through the A and E resistors in parallel, and the B and F resistors in parallel. During dialing, the off normal ON relay of FS2 is operated from ground on the P4 lead (4 option). The ON relay operated removes all shunt paths from the transmitting pair during pulsing.

1.08 In FS1, the shunt paths consist of the A capacitor and L, M, and T resistors in the shunt leg of the transmitting pad and the ST and SR capacitors and the ST and SR resistors of the sidetone bridge. After pulsing, the ON relay releases and restores all bridges to the line.

#### 243B KTU

1.09 Dial pulses generated in the key telephone set are transmitted to the line via the T and R leads of FS9 and through the A and E resistors in parallel, and the B and F resistors in parallel. During dialing, the off normal ON relay of FS2 is operated from ground on the P4 lead (6 option). The ON relay operated removes all shunt paths from the transmitting pair during pulsing.

1.10 In FS9, the shunt paths consist of the A capacitor and L, M, and T resistors in the shunt leg of the transmitting pad and the ST sidetone network (7 option) or the ST and SR capacitors and the ST and SR resistors of the sidetone bridge (G option). After pulsing, the ON relay releases and restores all bridges to the line.

### HOLDING

1.11 An incoming or outgoing call can be held by removing the ground from the A lead while retaining the station shunt on the T and R leads. Removing ground from the A lead releases the A-PU relay of FS4, in turn releasing the A relay which (a) in FS1 or FS9, closes the operating path of the H relay, allowing it to operate on line current through the telephone set; (b) prepares a holding path for the slow-release relay AH in FS5; and (c) transfers the lamp lead L in FS6 from steady to winking over

the path previously prepared by operation of relay AH.

1.12 Operation of relay H (a) closes its M8 contact, connecting its winding across the line as the holding bridge; (b) in FS5, closes a holding path for the slow release AH in time to prevent its release; and (c) in FS6, grounds the HA lead to the Visual and Audible Signal Circuit to start the interrupter for lamp winking.

1.13 The varistor H in FS1 or FS9 is in parallel with the winding of relay H to stabilize the sensitivity of the H relay when subjected to varying voltages.

### E. Release of the Holding Bridge When the Call Is Again Picked Up

1.14 When the line is re seized, ground on the A lead operates the A-PU relay in FS4, in turn operating the A relay, which opens the locking path of the H relay in FS1 or FS9 and removes the holding bridge. This restores the circuit to the talking condition.

### F. Release of the Holding Bridge from the Central Office or PBX

1.15 A permanent signal, caused by the hold circuit's not being released by a station, can be released from the central office or PBX by opening the line momentarily and allowing relay H to release and restore the circuit to normal.

### EXCLUSION

1.16 When manual cutoff (exclusion) is furnished the control station connects ground from the ER lead to the ET lead, operating the A-EX relay in FS3, which performs the following functions:

(a) Opens the following leads between the line circuit and the A-PU relays associated with stations that can be cut off: RT and RR in FS1 or FS9, SP or P4 in FS2, A2 in FS4, D or E in FS7, and FS8.

(b) Opens the T and R leads in FS1 or FS9 between the line circuit and the cutoff stations.

(c) Short circuits the RT and RR leads in FS1 or FS9 toward the cutoff stations.

### DISCONNECTION

1.17 When the station disconnects on either incoming or outgoing calls, ground is removed from the A lead in FS4, releasing the A-PU relay, which in turn releases the A relay, which releases the AH relay in FS5, and the circuit is restored to normal.

TRANSMISSION PADS

1.18 Transmission pads are provided in FS1 or FS9 in both the transmitting circuit and the receiving circuit. Optional strapping permits a choice of four fixed amounts of loss in steps of approximately 2 db.

SIDETONE NETWORKSG. Resistive Type (Options 4, G, and V)

1.19 The resistive network consists of resistors ST and SR and capacitors ST and SR in the line circuit. It provides a loss of approximately 20 db from the transmitting circuit to the receiving circuit for sidetone purposes, but also provides an echo return path from the receiving circuit to the transmitting circuit of equivalent loss. If two key telephone sets pick up the line, the sidetone and talkback levels may be inadequate for satisfactory communication between the two stations.

H. Active Type (Option 7)

1.20 The active network (256A KTU) contains a transistor which provides a uni-directional sidetone path as well as improved sidetone level stability if more than one key telephone station picks up the line. Power for the operation of the transistor is derived from the transmitter current. Sidetone losses of 17, 19, or 21 db are obtained by terminal strapping. The echo return loss through the network is at least 40 db from the receiving circuit to the transmitting circuit, which is desirable for long-haul circuits. It should be noted that proper line polarity is necessary on the T1 and R1 leads in FS1 or FS9 for the transistor network to function.

SPEAKERPHONE

1.21 Option F provides connections to 2- and 4-wire speakerphones which may be used in conjunction with one of the key telephone sets. Line circuit operation is the same for speakerphone use and telephone use.

SECTION III - REFERENCE DATA1. WORKING LIMITS

- 1.01 Maximum external conductor loop resistance - 1,200 ohms.
- 1.02 Minimum insulation resistance - 10,000 ohms.

2. FUNCTIONAL DESIGNATIONS

<u>Designation</u>	<u>Meaning</u>
A	Auxiliary
AH	Auxiliary Hold

DesignationMeaning

EX	Exclusion
H	Hold
ON	Off-Normal
PU	Pickup
R	Ringup, Receive or Ring
SR	Sidetone Ring
ST	Sidetone or Sidetone Tip
T	Transmit or Tip

3. FUNCTIONS

- 3.01 On 4-wire common battery central office lines or 4-wire PBX lines, this circuit provides for the following functions.
- 3.02 Flashing visual signals for incoming calls.
- 3.03 Common audible signals for incoming calls.
- 3.04 Steady visual signals while a station of the key telephone system makes a line busy.
- 3.05 Holding lines.
- 3.06 Winking visual signals to indicate a held line.
- 3.07 Removing the hold when a station of the key telephone system again seizes the line, or when the line is opened momentarily at the central office or PBX.
- 3.08 Transmission pads to adjust the transmitting and receiving levels.
- 3.09 Stations which can cut off other stations and cannot be cut off.
- 3.10 Stations which cannot cut off other stations and can be cut off at any time.
- 3.11 Sidetone from the transmitting path to the receiver.
- 3.12 Impedance matching of the receiver to the line.
- 3.13 Operation with 2- and 4-wire speakerphone.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on the keysheet, the connecting information thereon is to be followed.

(a) Crossbar Systems No. 5, Line Link and Marker Connector Control Circuit for Use with 4-Wire Lines - SD-26036-01.

(b) Auxiliary Service Transfer Circuit - SD-69422-01.

- (c) Crossbar Systems No. 5, Auxiliary Line Unit - SD-27517-01.
- (d) PBX Systems - Auxiliary Line Circuit - SD-65864-01.
- (e) Continuous Ringing Supply.
- (f) Key Telephone Systems No. 1A1 - Visual and Audible Signal Circuit - SD-69294-01.
- (g) Key and Telephone Circuit Arranged for TOUCH-TONE Calling on 2- and 4-Wire Common Battery Lines - SD-69423-01.
- (h) Key and Telephone Circuit for 2- and 4-Wire Common Battery Dial Lines - SD-69425-01.
- (i) Key and Telephone Circuit Arranged for TOUCH-TONE Calling on 2- and 4-Wire Lines - 1616-Type Telephone Sets - SD-69454-01.
- (j) Key and Telephone Circuit for 2- and 4-Wire Lines - 608- and 618-Type Telephone Sets - SD-69455-01.
- (k) Key and Telephone Circuits for 2- and 4-Wire Lines - Using Separately Mounted Keys - SD-69485-01.
- (l) Speakerphone Control Circuit for 2- and 4-Wire Lines - SD-69487-01.

#### SECTION IV - REASONS FOR REISSUE

##### A. Changed and Added Functions

- A.1 Operation with 2- and 4-wire speakerphone is added.

##### B. Changes in Apparatus

###### B.1 ADDED

256A KTU, App Fig. 7

###### B.2 SUPERSEDED

243A KTU, App Fig. 4  
201B KTU, App Fig. 5  
R Resistor KS-13490,  
List 1, 51 ohms  
±5 per cent,  
App Fig. 1, 4

###### SUPERSEDED BY

243B KTU, App Fig. 6  
201C KTU, App Fig. 5  
R Resistor KS-13490,  
List 1, 68 ohms  
±20 per cent, App  
Fig. 1, 4

#### D. Description of Changes

- D.1 FS9 is added.
- D.2 Options E, F, G, 6, and 7 are added.
- D.3 In FS1 the strapping for M option is corrected.
- D.4 In FS1 the value of resistor R is corrected from 51 ohms to 68 ohms.
- D.5 In FS2, FS4, FS6, FS7, and FS8 the location of multiple straps is changed for clarity.
- D.6 App Fig. 4 is rated Mfr Disc. and replaced by App Fig. 6 which is added and rated AT&TCo Std.
- D.7 In App Fig. 5 the 201B KTU, which has been rated Mfr Disc., is replaced by the 201C KTU.
- D.8 App Fig. 7 is added.
- D.9 Circuit Note 102 is changed.
- D.10 Circuit Note 107 is added.
- D.11 Information Note 302 is changed.
- D.12 Information Notes 303 and 304 are added.

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