

STATION SYSTEMS
4-WIRE SUBSCRIBER LINE CIRCUIT
WITH E AND M LEAD SIGNALING
ARRANGED FOR TERMINATING IN
2-AND 4-WIRE KEY TELEPHONE SETS

<u>TABLE OF CONTENTS</u>	<u>PAGE</u>	
<u>SECTION I - GENERAL DESCRIPTION</u>	1	via carrier or other means using "E" and "M" lead supervision.
1. PURPOSE OF CIRCUIT	1	(b) A talking battery supply for 2- and 4-wire key telephone set appearances of the 4-wire line.
2. CIRCUIT OPERATION	1	(c) Visual and audible signals to indicate the condition of the line.
2.1 Line Connection	1	(d) Pick-up relays, manual exclusion control, and the common circuits necessary for the proper functioning of lines associated with a key telephone system.
2.2 Originating a Call	1	
2.3 Incoming Call	1	
2.4 Disconnect	1	
<u>SECTION II - DETAILED DESCRIPTION</u>	2	(e) Joint operation with key equipment No. 112A, 4-wire central office line circuit.
1. LINE CONNECTION	2	
2. ORIGINATING A CALL	3	2. CIRCUIT OPERATION
3. INCOMING CALL	3	2.1 <u>Line Connection</u>
4. HOLDING	3	When an associated 4-wire station connects to the line (or subsequently holds the line) relay TB operates and connects battery on control lead "M" to the carrier facilities, located on the same premises, to signal the distant 4-wire No. 5 crossbar office that the 4-wire station is off-hook.
5. EXCLUSION	4	2.2 <u>Originating a Call</u>
6. AUXILIARY SERVICE TRANSFER	4	Relay TB also responds to pulses generated by the key telephone station rotary dial to cause alternate battery and ground pulses to be applied to the "M" lead during dialing.
7. JOINT OPERATION WITH KEY EQUIPMENT NO. 112A	4	2.3 <u>Incoming Call</u>
8. DISCONNECT	4	When an incoming call for the 4-wire station is received at the No. 5 crossbar office, this circuit is signaled via carrier facilities by a ground on the "E" lead. Relay R responds to the "E" lead ground by actuating visual and audible signals at the 4-wire station until the call is answered.
8.1 Key Telephone Station Disconnects First	4	2.4 <u>Disconnect</u>
8.2 Disconnect Signal from the No. 5 Office First	4	2.4.1 4-Wire Station Disconnects First
9. TRANSMISSION PADS	5	When the 4-wire station disconnects, the release of relay TB connects ground to control lead "M" to signal, via carrier facilities, the 4-wire No. 5 crossbar office that the 4-wire station is on-hook. The locked-open condition of the "E" lead
<u>SECTION III - REFERENCE DATA</u>	5	
1. WORKING LIMITS	5	
2. FUNCTIONAL DESIGNATIONS	5	
3. FUNCTIONS	5	
4. CONNECTING CIRCUITS	5	
<u>SECTION I - GENERAL DESCRIPTION</u>		
1. PURPOSE OF CIRCUIT		
This circuit provides:		
(a) Means for talking, holding, and signaling on a subscriber line connection between a 4-wire No. 5 crossbar office and a remote key telephone station		

continues until slow-release relay AH permits the release of relay LO at which time this circuit restores to normal, provided that the ground has been removed from the "E" lead.

2.42 Disconnect Signal from the No. 5 Office First

The on-hook signal from the No. 5 crossbar office is received at this circuit, via carrier facilities, as an open circuit in the "E" lead. However, the locked-open condition of the "E" lead in this circuit continues until slow-release relay AH permits relay LO to release and restore this circuit to normal, following disconnect by the 4-wire station.

SECTION II - DETAILED DESCRIPTION

1. LINE CONNECTION

When the line is picked up at the key telephone station, ground is placed on the "A" lead, operating the auxiliary pickup relay A-PU of FS-4 associated with the line and station. The pickup relay A-PU operated performs the following:

In FS-1:

- (a) Connects the telephone receiver leads "RT" and "RR" to the station side of the R repeating coil.
- (b) Connects, with "W" option, the passive sidetone network composed of capacitors ST and SR and resistors ST and SR between the key and telephone circuit transmit and receive pairs.
- (c) Connects, with "6" option, the active sidetone network ST which is powered by transmitter battery supply relay TB. The ST sidetone network provides adequate sidetone level when a second station is simultaneously off-hook, and, at the same time limits the echo volume to the distant station.

In FS-2, extends the "P4" lead to the ON relay.

In FS-3, extends the operating path of the relay A-EX ("3" option) over the "ET" lead.

In FS-4:

- (a) Places battery on the 4-wire class "FW" lead to operate a relay in the key and telephone circuit.
- (b) Closes ground to operate relay A.

In FS-9, extends an "S" lead from the key and telephone circuit to the Auxiliary Service Transfer Circuit, if provided.

In FS-10, extends a second "S" lead from the key and telephone circuit to the Auxiliary Service Transfer Circuit, if provided.

The operation of relay A in FS-4 performs the following:

In FS-1:

- (a) With "Y" option, removes idle terminating resistors T and R from the line and closes the talking path to the key and telephone circuit transmitter and receiver via the line circuit.
- (b) Provides a new operating path for relay TB.
- (c) Opens the operate path and removes the short circuit from the winding of relay H.

In FS-5, operates the auxiliary hold relay AH.

In FS-6:

- (a) Connects steady battery to the lamp lead "L" to the key and telephone circuit as a visual busy indication of the line.
- (b) With "Z" option, grounds the "KB" lead to operate a relay in joint use line circuit of the key equipment No. 112A.
- (c) With "Z" option, opens the "HA" lead to the Visual and Audible Signal Circuit.

When the line is picked up, relay TB in FS-1 operates in series with the transmitter, network, and normal dial contacts at a key telephone station. The operation of the TB relay (see FS-8):

- (a) With "Y" option, removes the ground normally connected to control lead "M" of the signaling circuit (directly with options "T" and "R", or via normal contacts of the Auxiliary Service Transfer Circuit with "S" option) and connects battery through resistance lamp M to the "M" lead as an off-hook signal to the central office.
- (b) With "Z" option, closes leads "TB" and "ON" to operate a relay in Key Equipment No. 112A 4-wire central office line circuit which relays the off-hook signal to the central office via lead "MC" and normal ON relay contacts.

The operation of the relay AH:

- (a) In FS-1, removes the shunt path, already opened when relay A operated, from the winding of relay H.

(b) In FS-6, prepares a circuit from the "LW" lead for control of the "L" lead, as described in 4.

(c) In FS-7, operates relay LO.

The operation of relay LO:

In FS-6:

- (a) Grounds the "CO" lead to the Visual and Audible Control Circuit.
- (b) With "Z" option, prepares a path in the "HA" lead to the Visual and Audible Control Circuit.

In FS-7, transfers control lead "E" of the signaling circuit from the incoming signaling relay R to relay LO in order to prepare a locking path for relay LO.

2. ORIGINATING A CALL

In response to rotary dial pulsing at the key telephone station, the alternate release and reoperation of relay TB signals the central office by closing ground or battery through resistance lamp M to the signaling circuit control lead "M" directly, with "Y" option, or through the operated ON relay contacts, with "Z" option. When "S" option is provided, the path to control the signaling circuit is via lead "MT" and normal relay contacts in the Auxiliary Service Transfer Circuit.

During dialing, the off-normal (ON) relay of FS-2 is operated from ground on the "P4" lead. In FS-1, the operation of relay (ON) removes the sidetone bridge shunt from pulsing relay TB. After pulsing, the ON relay releases and restores, with "W" option, the passive sidetone network or, with "G" option, the active sidetone network (ST).

In FS-8, with "Z" option, the operation of relay ON: (a) removes the closure of leads "TB" and "ON" to prevent pulsing of a relay in the key equipment No. 112A line circuit, (b) transfers control of the signaling circuit "M" lead to operated relay TB, and (c) opens the "MC" lead to prevent interference during the dialing period. After pulsing, the release of relay ON returns control of the signaling circuit "M" lead to the relay in key equipment No. 112A line circuit, held operated via the closure of leads "TB" and "ON", thus maintaining the off-hook signal to the central office.

When the called customer answers, the off-hook signal from the 4-wire No. 5 office arrives at this circuit as ground on the "E" lead. In FS-7, the ground on the "E" lead locks the previously operated relay LO which prevents a false incoming call signal at this time.

3. INCOMING CALL

When an incoming call arrives at this circuit, ground appears on the "E" lead to operate relay R in FS-7.

The operation of relay R causes in FS-6:

- (a) Ground to be connected to the "HA" lead to the Visual and Audible Signal circuit to start the electromechanical interrupter.
- (b) Closing of flashing battery on the "LF" lead from the Visual and Audible Signal Circuit via normal AH and A relay contacts to the "L" lead as a visual indication of an incoming call at the 4-wire station.
- (c) With "S" or "T" option, grounds the "CA" or "CA1" lead to the common audible signal circuit.
- (d) With "R" option, provides direct control of a station ringer.

Relay R stays operated until the call is answered or until ground is removed from the "E" lead.

4. HOLDING

A previously established incoming or outgoing call can be held by removing the ground from the "A" lead from the key and telephone circuit while at the same time retaining the station shunt on the "T" and "R" leads. Removing ground from the "A" lead releases relay A-PU of FS-4, in turn releasing relay A.

The release of relay A:

In FS-1:

- (a) Connects the winding of relay H in series with relay TB and the station shunt to operate relay H.
- (b) With "Y" option, restores idle line terminating resistors T and R to the 4-wire transmission path.

In FS-5, prepares a holding path for slow-release relay AH.

In FS-6:

- (a) Transfers the control of lamp lead "L" to the "LW" lead, thus changing the visual indication at the key and telephone circuit lamp from steady to winking when lead "HA" is grounded.
- (b) With "Z" option, grounds the "HA" lead to the Visual and Audible Control Circuit.

- (c) with "Z" option, removes ground from lead "KB" to the key equipment No. 112A line circuit.

The operation of relay H:

In FS-1, locks and places a shunt across the station "T" and "R" leads to hold relay TB operated.

In FS-5:

- (a) Holds slow-release relay AH operated in time to prevent its release.
- (b) With "Z" option, provides a closure of leads "B2" and "KH" to cause a visual indication at the key equipment No. 112A that the line is held.
- (c) In FS-6, with "Y" option, grounds the "HA" lead to the Visual and Audible Control Circuit.

The varistor H in FS-1 is in parallel with the winding of relay H to stabilize the sensitivity of the H relay when subjected to varying voltages.

Thus with relay TB held operated, battery via resistance lamp M in FS-8 is maintained on the "M" lead as an off-hook signal to the central office while the line is held or is in a talking condition.

When the call is picked up at the key and telephone circuit, ground on the "A" lead operates the A-PU relay in FS-4, in turn operating relay A which performs functions described in 2. In FS-1 the operation of relay A now releases relay H and restores the circuit to a talking condition.

5. EXCLUSION

When manual cutoff (exclusion) is furnished, the control station provides a closure of "ER" and "ET" leads to operate relay A-EX in FS-3, performing the following functions:

- (a) Opens the following leads between the line circuit and relays A-PU associated with stations that can be cut off: "RT", and "RR" in FS-1; "P4" in FS-2; "S" in FS-9 and FS-10; and the operate path of relay A in FS-4.
- (b) Opens the "T" and "R" leads in FS-1 between the line circuit and the cut-off stations.
- (c) Short-circuits the "RT" and "RR" leads in FS-1 toward the cutoff stations.

6. AUXILIARY SERVICE TRANSFER

Provision is made in FS-1 to connect the 4-wire transmission leads to the auxiliary service transfer circuit. In FS-7, when a closure is provided by that circuit to the "SG" and "LC" leads, ("S" option) relay LO is held operated. This provides for the case where relay AH is released while the line is transferred and prevents a false incoming signal.

7. JOINT OPERATION WITH KEY EQUIPMENT NO. 112A

Visual indication is provided at the key and telephone station whenever an attendant at key equipment No. 112A connects to, or holds, the line. Relay A in FS-4 is operated by a ground via lead "CB" from the associated line circuit to provide a busy indication. A held indication at the key and telephone station results when the line circuit associated with key equipment No. 112A provides a closure of the "CH" and "B1" leads to operate relay AH in FS-5. Pick-up of the line at either location releases a hold condition.

8. DISCONNECT

8.1 Key Telephone Station Disconnects First

When a key telephone station disconnects first on either incoming or outgoing calls, ground is removed from the "A" lead in FS-4, releasing relay A-PU, which in turn releases relay A, which releases relay AH. Relay AH, released, opens the holding path of relay LO, permitting the release of relay LO when ground is removed from the "E" lead to restore this circuit to normal. The release of relay TB when the key telephone station disconnects causes ground to be placed on the signaling circuit "M" lead as a station on-hook signal to the central office.

8.2 Disconnect Signal from the No. 5 Office First

When the central office is on-hook, ground is removed from the "E" lead by the signaling circuit to remove the locking ground for relay LO in FS-7. This circuit restores to normal following the release of the line at the key telephone station with "Y" option. The circuit restores to normal following the release of the line at both key equipment No. 112A positions and at key telephone stations with "Z" option.

9. TRANSMISSION PADS

Transmission pads are provided with "5" option in FS-1 for both the transmitting and receiving circuit where joint operation with key equipment No. 112A is not provided.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

None.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

On 4-wire dry subscriber lines, this circuit provides for:

- (a) Joint operation with key equipment No. 112A 4-wire Central Office Line Circuit.
- (b) Termination of the line when joint operation with key equipment No. 112A is not provided.
- (c) Flashing visual signals for incoming calls.
- (d) Steady visual signals when the line is busy at a station of the key telephone system or at key equipment No. 112A, or when the line is transferred to data facilities.
- (e) Common audible signals for incoming calls.
- (f) Talking battery supply.
- (g) Dial-pulsing arrangement with control of carrier via "M" lead signaling.
- (h) Recognition of ground on the "E" lead from carrier facilities as a central office off-hook signal on incoming and outgoing calls.
- (i) Holding lines.
- (j) Winking visual signals at key telephone system stations to indicate a held line.
- (k) Removing the hold when a station of the key telephone system or a position at key equipment No. 112A again seizes the line.
- (l) Stations which can cut off other stations and cannot be cut off.

(m) Stations which cannot cut off other stations and can be cut off at any time.

(n) Sidetone from the transmitting path to the receiver or on an active or passive basis when joint operation with key equipment No. 112A is not provided.

(o) Impedance matching of the receiver to the line.

(p) Data transfer arrangements.

(q) Optional use of transmission pads to adjust transmitting and receiving levels when joint operation with key equipment No. 112A is not provided.

4. CONNECTING CIRCUITS

When this circuit is listed on the key-sheet, the connecting information thereon is to be followed. The following are typical connecting circuits:

- (a) Crossbar Systems - No. 5 Auxiliary Line Circuit "E" and "M" Lead Supervision Office End - SD-27516-01.
- (b) Key Telephone Systems No. 1A1 - Visual and Audible Signal Circuits - SD-69294-01.
- (c) Key and Telephone Circuit for 2- and 4-Wire Common Battery Dial Lines - SD-69425-01.
- (d) Key and Telephone Circuit for 2- and 4-Wire Lines - SD-69455-01.
- (e) Key Equipment No. 112A, 4-Wire Central Office Line Circuit with "E" and "M" Lead Signaling - SD-69482-01.
- (f) Auxiliary Service Transfer Circuit for 4-Wire Lines with "E" and "M" Lead Signaling - SD-69491-01.
- (g) Key and Telephone Circuit for 2- and 4-Wire Lines Using Separately Mounted Keys - SD-69485-01.
- (h) Common Systems - N1 Carrier Telephone Application Schematic for Terminal - SD-95121-01 (typical).
- (i) Common Systems - E3B Signaling Circuit 2400 or 2600 Cycle "E" and "M" Lead Supervision - SD-98124-01 (typical).
- (j) Power Systems - Continuous Ringing Supply.

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