STATION SYSTEMS
KEY TELEPHONE SYSTEMS NO. 1A, 1A1, 1A2 AND 6A
630DA, 631DA, 2630DA, 2631DA
TELEPHONE SET CIRCUIT
18- AND 30- BUTTON CAPACITY
FOR USE WITH 2-WIRE LINES ARRANGED FOR DIAL PULSE OR "TOUCH-TONE" CALLING AND HANDSET OR SPEAKERPHONE OPERATION

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit provides station talking and listening circuits, TOUCH-TONE* or rotary dialing arrangements, with pickup keys for connection to a maximum of 17 lines in 630- and 2630- type telephone sets and 29 lines in 631- and 2631- type telephone sets. Line may be 2-wire central office, PBX, private, or intercommunication lines of telephone system No. 1A, 1A1, 1A2, and 6A. It also provides for holding one or more lines, offers signal lamps which light the key buttons, and offers a ringer which may be associated with one or more lines as a common ringer. Pickup keys may be converted to nonlocking operation and used to provide individual or common signaling functions on private or intercommunication lines. The circuit shows information to connect to 3- or 4- type speakerphone system for hands-free use.

SECTION II - DETAILED DESCRIPTION OF 1A1 AND 1A2 KEY TELEPHONE SYSTEMS

1. TRANSMITTING AND RECEIVING - FS1, FS2 ON 2-WIRE LINES

1.01 The handset and network circuits, shown connected to rotary dial FS1 and to TOUCH-TONE dial FS2, function in the usual manner as a common battery subscriber station circuit.

2. LINE SELECTION --FS3, FS4

PICKUP KEYS

2.01 Pickup keys are locking type and have three make contacts. When a pickup key is operated, the common circuits of the telephone set are connected to the line associated with the key. The pickup keys are furnished in key units: 635A5C key consists of five pickup keys and a hold key, and 635G5C, option Z, consists of six pickup keys. Mechanical lockout releases any operated pickup key when another pickup key is operated in the same key unit and prevents operation of two key plungers at one time. A latch bar mechanism releases any operated pickup key in other key units, but does not prevent simultaneous operation of a pickup key in the other key units.

2.02 Connections to the pickup keys are made by means of separate colored plugs for each line. These plugs are part of the mounting cord. Lines may be interchanged by connecting the colored plug of any line to any pickup key of a key unit. The common tip and ring leads for each key unit consists of two metal contact strips with pins for connection to the keys. These strips are located underneath the colored plugs and terminate in spade-tipped leads for connection to the common circuits and to other key units via terminals on the terminal board.

CHAINING SWITCH

2.03 A chaining switch consisting of three break contacts is furnished in each key unit to prevent simultaneous connection to two or more lines in different key units. Operation of any pickup key operates the chaining switch in that key unit, disconnecting the common circuits from succeeding key units. Thus, should pickup keys of two or more key units be operated simultaneously, the chaining switches permit only the operated pickup key of the left key unit to connect its lines to the common circuit.

2-WIRE LINES

2.04 When a pickup key is operated, the common circuits of the telephone set are connected to the line circuit associated with that key, and a call may be answered or originated in the usual manner.

3. SIGNALING

VISUAL SIGNALS - FS7, FS11

A. Lighted Keys - FS7

3.01 Lamps are provided to light the pickup and hold key buttons. The lamps are controlled by the associated line circuits or lamp control circuits which provide distinctive signals by lighting the lamps steadily or with various interruption rates.

B. Auxiliary Lamp Socket - FS11

3.02 When additional lamps are required in the telephone set, a 76A lamp socket may be installed in place of a pickup key unit. The lamp socket consists of two rows of six lamps each. The left row, lamps 1 through 6, is connected to the same cord and cable conductors of the pickup key tips and rings. The right row, lamps 7 through 12, is connected to the same cord and cable conductors as the lamps of the pickup keys which the lamp socket replaces. The lamp socket is connected to the cord by means of colored plugs the same as the pickup key unit. The lamp socket must be located in a key position to the right of the last position equipped with a pickup key unit and to the left of the internal speakerphone transmitter if the telephone set is so equipped.

AUDIBLE SIGNALS - FS8, FS9

A. Ringer - FS8

3.03 A ringer and capacitor are provided in the telephone set for use as either a line

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ringer or a common ringer. The ringer is connected with the capacitor when used as a bridge ringer on central office or PBX lines and when the power failure feature is provided. The ringer may be connected with or without the capacitor for a private line signal, intercommunication signal, or common signal as required. No provision is made inside the telephone set for associating the ringer with a particular line. Leads R-R1 and B-B1 shall be connected externally for the desired type of operation.

B. Buzzers - FS9

3.04 A mounting bracket for buzzers is provided inside the telephone set. It is arranged to mount one or two KS-8109, L2 buzzers, options Y or X, or KS-20419, L1 buzzers, option W, or combinations of the 2 types of buzzers. Telephone sets manufactured after December 31, 1972, will be equipped with KS-20419, L1 buzzer, option W. While the KS-20419, L1 buzzer may be mounted under any convenient screw head that does not cause electrical or mechanical interference with other apparatus, the KS-8109, L2 buzzer shall always be mounted so that its frame is insulated from the base of the telephone set. This is best accomplished by mounting the KS-8109,L2 buzzer only to the mounting bracket.

3.05 The KS-8109,L2 buzzer may be operated from 14-30 volt dc supply using wiring option Y or from 14-30 volt, 60-Hz ac supply using option X. The KS-20419, L1 buzzer, option W, shall be operated from 10 volt, 60-Hz ac supply only.

3.06 A pair of leads, BZ(S-Y) and BZ1(Y-S), in orange-white binder are dedicated for buzzer use. When more than one buzzer is required, spare pairs shall be used.

CONVERTIBLE KEYS - FS4

3.07 All keys except the hold key can be converted from pickup to signaling or vice versa. Transfer and loopback functions may be assigned to these keys when such circuits are furnished. The keys are converted from locking to nonlocking by removing the threaded pin from the plunger. The circuit is rearranged for signaling by moving one or more spade-tipped leads on the terminal board. Such connections are described in detail in the Bell System Practices. When keys are used for signaling, the key contacts and cord conductors normally used for A lead functions are used for the signaling functions and are designated S or S1.

COMMON SIGNALING KEYS - FS4

3.08 The telephone set can be arranged for signaling on private or intercommunication lines by means of a common signaling key. On such lines lead A is not required, so it is used as leads S or S1 for signaling. In such an arrangement, several lines may have their S or S1 leads extended through the pickup key contacts and, by means of associated spade-tipped leads, connected to one key which has been arranged for signaling whichever line has its pickup key operated. Such connections are described in detail in the Bell System Practices. The common signaling key is converted to nonlocking by removing the threaded pin from the plunger.

ADDITIONAL SIGNAL KEYS - FS12

3.09 When additional signal keys are required in the telephone set, a 658A key may be installed in place of a pickup key unit. The key consists of two rows of six buttons each. The left row, buttons 1 through 6, is connected to the same cord and cable conductors (L designation) as the pickup key lamps 1 through 6. The right row, buttons 7 through 12, is connected to the same cord and cable conductors (LG designation) as the lamp grounds 1 through 6 of the pickup key which this key replaces. The key is connected to the cord by means of colored plugs in the same manner as the pickup key unit. It must be located in a key position to the right of the last position equipped with a pickup key unit and to the left of the internal speakerphone transmitter if the telephone set is so equipped.

3.10 The common lead of buttons 1 through 6 is connected to terminal 17 of the terminal board. The common lead of buttons 7 through 12 is connected to terminal 18 of the terminal board. Terminals 17 and 18 are connected by means of a removeable strap. The SG ground lead is connected to terminal 18. When required, the strap between terminals 17 and 18 may be removed and a one-wire cord connected to terminal 17 at one end. The other end is connected to a dissimilar ground or to other circuits. This is to provide separate common connections to the two rows of buttons.

DIALS

A. TOUCH-TONE Dial - FS2

3.11 A pushbutton dial 35C3A is provided for generating and transmitting the TOUCH-TONE frequencies to the switching equipment. The dial contains a transistor oscillator capable of generating two frequencies simultaneously. The oscillator is powered by line current. In addition to the ten regular numerical buttons, this dial has two additional buttons, * and #, for generating additional signals as may be required by the circuits to which the telephone set has access. When a button is operated, two frequencies are generated by the oscillator. A common switch on the dial operates when any button is pushed. The switch disconnects the handset transmitter circuit from the network and connects the dial output circuit in its place, thus transmitting the two frequencies

over the line to the switching equipment. In addition, small amounts of the transmitted tones are fed back to the handset receiver to assure the user that the tones are being transmitted. These tones are fed back through a 5100 ohm resistor in the dial.

B. Polarity Guard - FS13

3.12 Polarity guard PG, option V, may be provided when necessary to maintain proper polarity for operation of the TOUCH-TONE dial regardless of line polarity. Such a use would be end-to-end signaling after a connection is established. The polarity guard consists of a semiconductor diode bridge rectifier, a breakdown diode to limit voltage surges to a safe value, and two series resistors to limit the current surges.

C. Rotary Dial - FS1

3.13 Rotary dial sets are furnished with either of two dials. Dial 8C, options B, E, or ZA, has a pulsing contact and two sets of off-normal contacts. The pulsing contact PLS makes and brakes the line current to signal the switching equipment. When the dial is rotated off-normal, contact ON makes to short circuit the handset receiver to prevent acoustic disturbances, and contact ON1, FS14, makes to provide switching for an external circuit, such as muting a speakerphone loudspeaker during dialing. Dial 8R, option A or ZB, has a pulsing contact and one off-normal contact. Operation of the 8C dial is similar to that of the 8C dial, except for the absence of the ON1 off-normal contact for external circuits.

LINE SWITCH - FS1, FS2, FS4

3.14 Line switch (LS designation), having three sets of contacts, is provided. The continuity transfer contacts a, b, and c operate first when the handset is removed and restored last on hangup. This sequence prevents a false hold condition when the telephone set is connected to line circuits having A lead control. The normally open set of contacts d and e controls the talking circuit to the telephone set. They make after contacts b and c make and before contacts a and b break, and they restore after contacts a and b make and before contacts b and c break. The normally closed set of contacts f and g short circuit the handset receiver. They are arranged to break after the other contacts and restore before the other contacts to eliminate acoustic disturbances due to the transients produced by the other contacts.

4. HOLDING - FS4, FS15

REGULAR HOLD - FS4

4.01 A hold key is provided for use with line circuits having the holding feature. Operation of the hold key opens the A lead, permitting the hold relay in the line circuit to operate. Release of the hold key restores the operated pickup key through mechanical linkage. The hold relay remains operated, holding the line until the line is picked up again at the same or at another station. During the time the line is held, the lamp in the pickup key of the held line will indicate the hold condition by a suitable interruption rate. When the line is again picked up, the A lead is closed and the holding condition is removed by release of the hold relay. The lamp will return to a steady on condition.

SUPPLEMENTARY HOLD - FS15

4.02 The supplementary hold circuit for line circuits having A lead control provides a special lamp-flutter hold indication in addition to the normal lamp wink associated with regular hold. The supplementary hold circuit may be connected to provide two features, priority hold and I hold.

PRIORITY HOLD - OPTION G

4.03 In the priority hold configuration, the lamp-flutter signal is provided to all stations picking up the lines that are equipped for this feature. A kit of parts, D-180411, consisting of a key unit, 635A5C and a pink plug, 509A, with spade-tipped leads, and two contact strips, is required. Assemble and connect the kit of parts to the set in accordance with Note 1 and option G of FS15. The hold button of a second key unit is used to activate the priority hold function.

I HOLD - OPTION F

4.04 The I hold configuration provides the lamp-flutter signal only to the set initiating the hold. This arrangement requires only th regular hold key wired according to option F of FS15.

5. STATION BUSY LAMP - FS14

5.01 The station busy lamp feature provides for lighting a lamp at a remote location to indicate that a particular station is off-hook by monitoring the c contact of the line switch. The c contact also connects ground to the A leads of the line circuits. Thus, the station busy lamp circuit is connected in parallel with the A lead circuit. A diode is connected in the A lead circuit, as shown in FS14, to prevent a false operation of the busy lamp circuit when the station is idle. This false operation would be caused when another station associated with the same line circuit is operated causing the A lead circuit to be grounded.

6. 3- AND 4- TYPE SPEAKERPHONE - FS17, FS18, FS19, FS20

6.01 Connecting information is shown for the 3- type internal transmitter in FS17, 3- type external transmitter in FS18 (option B), and 4- type external transmitter in FS19 (option ZA), 4- type internal transmitter in FS20.

3- TYPE INTERNAL TRANSMITTER - FS17

6.02 When desired, A 679A transmitter shall be installed in the telephone set in the last key unit position (farthest right key unit position). This transmitter is arranged to accept the slate-colored plug of the mounting cord for connection to the last plug. All other plugs associated with the last key unit position shall be insulated and stored. Connect the spade-tipped (S-V) lead of the transmitter to the terminal board, terminal 4.

6.03 All other connections between the telephone set and the 3- type speakerphone internal transmitter shall be made via the last plug of the mounting cord. Rearrange the connections in accordance with Table D and FS17.

3- TYPE EXTERNAL TRANSMITTER - FS18, OPTION B

6.04 Conductors are provided in mounting cord D16F to connect the 666B external transmitter and the 55B control unit to the telephone set. Arrange the connections in accordance with Table E and FS18.

6.05 If the 3- type control unit, 55B, of the speakerphone system is at the station location, the key system A1 ground lead (not to be confused with the internal or external transmitter A1 lead) may be extended through the last plug of the D120K or D200S mounting cord for the internal transmitter or the D16F mounting cord for the external transmitter. It may also be run from the equipment via the connector cable as shown in FS17 and FS18.

4- TYPE SPEAKERPHONE SYSTEM

6.06 The 4- type speakerphone system consists of a transmitter, loudspeaker set, power unit, and adapter that, when connected to a suitable telephone set, provides hands-free telephone operation, on-hook dialing (when dial is not obstructed), automatic switching from speakerphone to handset operation, transmitter muting for private conversion, visual indication when system is in use, cutoff common ringer, or other signaling devices when desired. Refer to BSPs 512-700-100 and 512-730-400 for detailed information.

4- TYPE EXTERNAL TRANSMITTER - FS19, OPTION ZA

6.07 Conductors are provided in mounting cords D8S, M16C, D20N, D120K, and D200S to connect the 680A external transmitter, 108A loudspeaker set, and 223A adapter to the telephone set. Arrange the connections in accordance with Tables F and G and FS19.

LOUDSPEAKER SET AND TRANSMITTER 4- TYPE SPEAKERPHONE

6.08 The loudspeaker set and transmitter must be placed a minimum of one foot apart and not directly facing each other. The transmitter must be at least two feet from the transformer or any ac-powered device.

6.09 Unused speakerphone leads in the mounting cords shall be disconnected, insulated, and stored to prevent interference with working circuits. These leads shall never be multipled between telephone sets. Refer to section 502-110-100 for more detailed information.

4- TYPE INTERNAL TRANSMITTER - FS20

6.10 Conductors are provided in mounting cords M24L, D20N, D120K, and D200S to connect the 681A internal transmitter, 108A loudspeaker set, and 223A adapter to the telephone set. The 681A internal transmitter shall be installed in the last key unit position (farthest right key unit position). Remove the key unit from the last key unit position. Remove all the colored 508- type plugs from the key unit, insulate, and store. Install mounting cord M24L and plug in the slate plug (part of mounting cord M24L) into the 681A internal transmitter. Connect the (O-W) LK lead from the 681A internal transmitter to terminal 4 of terminal board 1. Install the 681A internal transmitter in the last key unit position.

RINGER CUTOFF, OPTION ZD, 4- TYPE SPEAKERPHONE

6.11 Ringer cutoff feature, option ZD, provides for cutting the telephone set ringer off through relay contacts located in the loudspeaker set while on speakerphone.

AUXILIARY RELAY, OPTION ZC, 4- TYPE SPEAKERPHONE

6.12 The auxiliary relay feature provides a relay contact closure for operation of an auxiliary relay key telephone unit when it is desired to cut off several signals. The signal circuits must be wired through the contacts of the auxiliary relay, FS19, option ZC.

MOUNTING CORDS, 4- TYPE SPEAKERPHONE

6.13 Mounting cords that connect the loudspeaker set, transmitter, power unit, and adapter are only available in satin silver finish (-87) and in 7-, 13-, or 25-ft lengths, except for M2FG mounting cord which is always 25 feet. If 13- or 25-ft mounting cords are not specified, the standard 7-ft mounting cord will be furnished.

7. CUTOFF KEY - FS16

7.01 When a cutoff key is required, the first key unit position can be equipped with a 635AD5C key unit, which is arranged for a push-to-lock, push-to-release key in place of the fifth pickup key and adjacent to the hold key. The push-push key is equipped with two sets of transfer contacts. An adapter is provided with the 635AD5C key unit to provide the wiring transition between the slate plug of the mounting cord and transfer contacts of the push-push key. New contact strips for the common tip and ring connections must be ordered separately to replace those on the 635A5C key unit. See the appropriate apparatus figure on the SD for ordering information.

7.02 It is necessary to disconnect any line circuits and all multiplies from the conductors to be associated with the cutoff key to prevent interference with other circuits.

7.03 To install the cutoff key, remove the colored plugs and contact strips from the 635A5C key unit and disconnect the contact strip leads from their terminals on the terminal board. Install the new contact strips, the adapter, and the colored plugs on the 635AD5C key unit. Connect the common tip and ring leads of the new contact strips to their terminals on the terminal board. The (BL-Y) and (Y-BL) leads of the adapter and the (BK-BR), (S-BK), and (BK-S) leads of the slate plug may be connected as required. See the appropriate Bell System Practice for detailed connection information. The (BR-BK) lead of the slate plug shall be disconnected from terminal 10 of the terminal board in all cases. It may be connected as required or insulated and stored.

8. CONNECTION TO VARIOUS CENTRAL OFFICE OR PBX LINE CIRCUITS

1A1 OR 1A2 LINES

8.01 The telephone set is shop wired for Key Telephone Systems No. 1A1 and 1A2 line circuits only and is used as furnished.

1A AND 1A1 OR 1A2 LINES

8.02 When the telephone set is connected to line circuits of the Key Telephone Systems No. 1A, 1A1, and 1A2, the 1A1 or 1A2 line circuits shall be connected to pickup keys in the first key unit position, then the second key unit position, etc, as required. (The first key unit position is the position to the right of the dial.) Central office or PBX line circuits of Key Telephone Systems No. 1A1 and 1A2 may be connected to the same key unit. Line circuits of Key Telephone System No. 1A shall be connected to pickup keys in the succeeding unused key unit. Central office or PBX line circuits of Key Telephone Systems No. 1A and 1A1 or 1A2 shall not be connected to the same key unit. To convert key units from 1A1 or 1A2 line circuits to 1A line circuits is described in Circuit Notes 109, 110, 111, 112, and 113.

1A LINES ONLY

8.03 The information necessary to convert key units to 1A line circuits is contained in circuit notes 109, 110, 111, 112, and 113 of the SD.

9. RADIO FREQUENCY NOISE SUPPRESSOR

9.01 A radio frequency suppressor for dial interference is built into network 4010B.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Maximum loop resistance between this circuit and the lamp power supply is 50 ohms.

2. FUNCTIONAL DESIGNATIONS

2.01 Dial, Rotary

Designation	Meaning
PLS	Pulsing Contact
ON	Off-Normal Contact
ON1	Second Off-Normal Contact (speaker-phone only)

2.02 Handset

Designation	Meaning
RCVR	Receiver
TRMTR	Transmitter

2.03 Transmitter, Speakerphone

Designation	Meaning
TRMTR1	3- Type Speaker-phone Transmitter
TRMTR2	4- Type Speaker-phone Transmitter

3. FUNCTIONS

3.01 Provides a handset and anti-sidetone transmission circuit for connection to 2-wire common battery lines.

3.02 Provides for picking up a maximum of 17 or 29 lines.

3.03 Provides for operation of holding circuits.

3.04 Provides a ringer and a buzzer as audible signals.

3.0k Provides TOUCH-TONE dialing by means of a pushbutton dial.

3.06 Provides dial pulse dialing by means of a rotary dial.

3.07 Provides keys that may be converted from pickup (locking) to signaling (nonlocking).

3.08 Provides a common signaling key to signal on two or more private or intercom lines.

3.09 Provides for arrangement of the lines on the keys by means of plug-ended line conductors.

3.10 Provides lamps as visual signals.

3.11 Provides a plug-ended mounting cord.

3.12 Provides signaling keys arranged to operate local circuits.

3.13 Provides for operation with 2-wire speakerphone.

3.14 Provides for a cutoff key.

3.15 Provides for auxiliary lamps and signaling keys.

3.16 Provides arrangement for station busy.

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4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a keysheet, the connecting information thereon is to be followed. The following are typical connecting circuits:

(a) Key Telephone System No. 1A2 - CO or PBX Line Circuit - SD-69513-01.

(b) Key Telephone System No. 1A1 - CO or PBX Line Circuit - SD-69270-01.

(c) Key Telephone System No. 1A1 - Visual and Audible Signal Circuit - SD-69294-01.

(d) Station Connector Cables and Associated Components - SD-69368-01.

(e) Key Telephone Systems No. 1A1 and 1A2 - Multiline Exclusion Circuit - SD-69489-01.

(f) Key Telephone System No. 1A1 or 1A2 - Station Busy Lamp Circuit - SD-69580-01.

(g) Key Telephone System No. 1A1 or 1A2 - Supplementary Hold Circuit - SD-69530-01.

(h) Key Telephone System No. 1A - Line and Signaling Circuit - SD-69136-01.

(i) Key Telephone System No. 6A - Intercommunicating Line Circuit - SD-69286-01.

(j) Speakerphone System No. 3B - Telephone and Speakerphone Circuit - SD-69403-01.

(k) Speakerphone System No. 4A.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 Manufacturing testing requirements are contained in drawing A-243135.