STATION SYSTEMS
50A CONFERENCE SET
(73A CONTROL UNIT)
CIRCUIT

CHANGES

F. Changes in Description of Operation

F.1 The title has been changed to read:

STATION SYSTEMS
50A CONFERENCE SET
(73A CONTROL UNIT)
CIRCUIT

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3325-JAD-FEF

STATION SYSTEMS
50A CONFERENCE SET
CIRCUIT

CHANGES

B. Changes in Apparatus (Components)

B.1 In FS1

Removed	Replaced By
C4 Capacitor 603A, 4μF (Z option)	C4 Capacitor 601A, 5μF (Y option)

B.2 In CPS2

Removed	Replaced By
R24 Resistor KS-16645 L1, 24 ohms	R24 Resistor 237A, 1 ohm

D. Description of Changes

D.1 Option Index added to Sheet Index

D.2 In FS1; LSPR for CP2 was changed to PWR

R27 for CP2 was changed to R28

ICJ at CP4 was changed to J

D.3 In App Fig. 1:

CPS1 Dwg No. 84028365 was changed to 840284400.

CPS2 Dwg No. 840283873 was changed to 840284426.

Capacitor C4,603A (Z option) was changed to 601A (Y option).

D.4 In Circuit Notes, Z and Y options were added to Note 103.

D.5 In CPS1 (sheet J1B) circuit pack code and assembly drawing No. was changed to 840284400.

D.6 In CPS2 (sheet J2A), the value of resistor R24 was changed to 1.0 ohm.

D.7 In CPS2 (sheet J2B) circuit pack code and assembly drawing No. was changed to 840284426 and resistor R24 was changed from KS-16645 L1, 24 ohms to 237A, 1.0 ohm.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3325-WDG-FEF

STATION SYSTEMS
50A CONFERENCE SET
CIRCUIT

TABLE OF CONTENTS PAGE

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit provides facilities for hands-free communication, over the switched telephone network, by a group of people in a classroom, meeting room, or small auditorium.

2. GENERAL DESCRIPTION OF OPERATION

EQUIPMENT

2.01 The conference set consists of a 73A control unit, two plug-in omnidirectional microphones with accessories, power and telephone line cords, and a carrying case.

2.02 The control unit contains a unidirectional (cardioid) microphone, a loudspeaker, electronic circuits, a volume control, provision for a TRIMLINE® handset, a ringer, and keys to control the mode of operation. Provision for the handset includes a cord reel with plug-ended cord and a switchhook located in the handset cradle that is molded into the front cover of the control unit.

2.03 Jacks are provided in the control unit for connecting the power cord, the telephone line cord, the two plug-in microphones, and a TOUCH-TONE telephone set. Screw terminals are provided for connection to a customer-owned public address system.

OPERATION

2.04 The control unit microphone or one of the plug-in microphones is used for talking to the distant party. The distant party is heard through the loudspeaker. All microphones can be deactivated to provide one-way communication. The TRIMLINE handset is used to originate a call and can be used at any time in place of the hands-free circuit. The external TOUCH-TONE telephone set (if provided) is used to provide audible TOUCH-TONE

signals for data input to a computer terminal.

SECTION II - DETAILED DESCRIPTION

1. DESCRIPTION OF OPERATION

ORIGINATING A CALL

1.01 The handset must be used to originate a call. When the handset is lifted, the talking path is connected to the handset through a make-contact of the operated switchhook. Battery for the dial lamp is furnished through a second make-contact. A break-contact prevents the hands-free circuits from being activated. After dialing is completed, the call can be transferred to hands-free operation.

ANSWERING A CALL

1.02 A call can be answered with the handset and then transferred to hands-free operation.

1.03 A call can be answered using hands-free operation by depressing the SET MIKE button. This button operates a locking key with three make-contacts to provide the following functions:

(a) Connects the control unit microphone to the hands-free circuits.

(b) Connects ground to relay K1 through closed contacts of the switchhook and the OFF key; relay K1 operates.

(c) Connects the lamp battery lead to lamp DS1.

1.04 Relay K1 operated:

(a) Connects the tip and ring leads to the hybrid coil of the hands-free circuits.

(b) Activates the power supply, thus furnishing battery to the hands-free circuits and the lamp battery lead. The appropriate lamp is lighted.

(c) Provides a lockup path which parallels the key contact.

(d) Removes a short circuit from the receive channel of the hands-free circuits.

(e) Discharges the NOGAD precharge circuit through the control variolosser.

SHIFTING FROM HANDSET TO HANDS-FREE OPERATION

1.05 To change from handset to hands-free operation, depress the SET MIKE button. Operation is similar to 1.03 except that ground is supplied to relay K1 only when the handset is replaced, closing the switchhook contact.

HANDS-FREE OPERATION

A. Use of Control Unit Microphone

1.06 To use the control unit microphone, depress the SET MIKE button. Operation is identical to that explained in 1.03.

B. Loudspeaker

1.07 The incoming signal is heard through the loudspeaker. Signal level can be adjusted by means of the VOLUME control.

C. Use of Remote Microphones

1.08 To use either color-coded remote microphone, the plug must be inserted into the respective jack, J1 or J2. The GOLD MIKE and GREEN MIKE buttons operate locking keys with three make-contacts to provide the following functions:

(a) Connect the appropriate jack to the hands-free circuits.

(b) Connect ground to relay K1 through closed contacts of the switchhook and the OFF key.

(c) Connect the lamp battery lead to the appropriate lamp.

Note: Ground is supplied to lamps DS2 and DS3 only when a plug is inserted in the appropriate jack, closing a make-contact.

D. Providing Local Privacy

1.09 When the MIKES OFF button is depressed, no microphones are connected. This button operates a locking key with two make-contacts to provide the following functions:

(a) Connect ground to relay K1 through closed contacts of the switchhook and the OFF key.

(b) Connect the lamp battery lead to lamp DS5.

E. Use of External Telephone Set For TOUCH-TONE Signaling

1.10 When the plug of a TOUCH-TONE telephone set (see Equipment Note 201) is inserted into jack J3, the tip side of the line is removed from the hybrid coil and supplied to the T lead of the telephone set. Tip is returned to the hybrid coil through the T1 lead of the telephone set. The AUX DIAL button operates a locking key with three make-contacts to provide the following functions:

(a) Connect ground to relay K1 through closed contacts of the switchhook and the OFF key.

(b) Connect the lamp battery lead to lamp DS4.

(c) Connect the ring side of the line to the IR lead of the telephone set.

1.11 The dial on the external telephone operates in the normal manner without the handset being lifted. TOUCH-TONE signals are transmitted to the telephone line and, at reduced level, to the hands-free circuits.

F. Operation of Keys

1.12 Only one of the five locking keys can be operated at one time. When a button is depressed, any button that has previously been depressed is returned to its normal position.

G. Public Address Output

1.13 The outputs of both the transmit and receive channels of the hands-free circuit are combined at a single transformer-coupled output. The signal level is typically -45 dBV at an impedance level of 600 ohms.

H. Shifting From Hands-Free to Handset Operation

1.14 When the TRIMLINE handset is lifted, ground is removed from relay K1 by means of the opened switchhook contact. Relay K1 releases and the handset operates as described in 1.01.

1.15 Relay K1 released:

(a) Removes the tip and ring from the hybrid coil of the hands-free circuits.

(b) Deactivates the power supply, thus removing battery from the hands-free circuits and the lamp battery lead.

(c) Places a short circuit across the receive channel of the hands-free circuits to prevent transients that would otherwise occur when the telephone line is removed from the hybrid coil.

(d) Allows the NOGAD precharge circuit to charge.

I. Terminating a Call

1.16 A hands-free call is terminated by depressing the nonlocking OFF button. Ground is removed from relay K1 causing it to release. When the OFF button is released, the previously depressed locking button is released.

1.17 A handset call is terminated by replacing the handset in its cradle. If any of the five locking buttons have been depressed, it is necessary to operate the OFF button in addition to replacing the handset.

2. DESCRIPTION OF EQUIPMENT

73A CONTROL UNIT

2.01 The 73A control unit is intended to be placed on a desk or table. Its dimensions are approximately 10 inches wide, 12 inches deep, and 5 inches high. The unit weighs approximately 13 pounds.

2.02 The front cover of the control unit provides a molded cradle for the TRIMLINE handset. A switchhook is located in the cradle. A plug-ended handset cord is attached to a cord reel within the control unit. Also located on the front portion of the unit are the VOLUME control, the buttons to control the mode of operation, and a grille to protect the control unit microphone.

2.03 The back face of the unit provides a grille to cover the loudspeaker and contains jacks for connecting the power and telephone line cords, the remote microphones, and an external telephone set.

2.04 Screw terminals for connecting to a public address system are located on the bottom of the unit.

2.05 The electronic circuits are mounted, primarily, on six printed circuit cards.

MICROPHONES

2.06 The control unit microphone is of the unidirectional (cardioid) dynamic type.

2.07 The two remote microphones are of the pressure (omnidirectional) dynamic type. They are equipped with 20-foot plug-ended cords.

LOUDSPEAKER

2.08 The loudspeaker is a 3- by 5-inch oval unit. Its nominal impedance is 12 ohms.

CARRYING CASE

2.09 The carrying case has provision for transporting the control unit with handset in place, the two remote microphones with accessories, the power cord, and the telephone line cord. The complete conference set in the carrying case weighs approximately 19 pounds.

3. DESCRIPTION OF CIRCUITS

GENERAL DESCRIPTION

A. Transmission Circuits

3.01 The control unit contains four amplifiers which provide the necessary gain in the transmit and receive channels. The trans-

mit channel consists of the microphone, two amplifiers, and the transmit variolosser. The receive channel consists of two amplifiers, the receive variolosser, and the loudspeaker. The variolossers insert loss in the idle channel to protect against singing and excessive return echo. The two channels are joined with the telephone line by the hybrid coil T1.

3.02 The sum of the losses switched by the transmit and receive variolossers is a constant function of the volume control setting. When the set is in the quiescent and receive states this loss is present in the transmit variolosser. When the set is in the transmit state, the loss is present in the receive variolosser.

B. Control Circuits

3.03 When the local speech level exceeds the switching threshold, loss is removed from the transmit variolosser and inserted into the receive variolosser. This switching of states is accomplished by the direct current output of the control amplifier which passes through both variolossers.

3.04 The switchguard circuit provides protection against false operation of the voice switch due to received signal.

3.05 The NOGAD circuit provides protection against false operation of the voice switch due to steady room noise.

3.06 The VOLUME control adjusts the steady state bias current through the variolossers, thus setting the gain of the receive channel and determining the amount of loss to be switched between channels.

DETAILED DESCRIPTION

A. Transmit Channel Circuits

Preamplifier

3.07 The preamplifier is contained in CP2. This circuit provides 82 dB of voltage gain to raise the microphone output to a level suitable to drive the remaining circuits. The amplifier has a rising frequency characteristic that approximates 3 dB per octave up to 3 kHz. This characteristic provides good intelligibility while reducing unwanted reverberant energy.

Transmit Variolosser

3.08 The transmit variolosser is contained in CP3. It is a balanced series variolosser which provides 76 dB of insertion loss when no direct current is flowing through the varistors. The insertion loss is reduced to 39 dB when 1.5 mA of direct current is flowing.

Transmit Amplifier

3.09 The transmit amplifier is contained in CP3. This amplifier provides 38 dB of power gain. Series feedback at both input and output raises the respective impedances so that resistive terminations at the input and output (CP2) stabilize the impedances presented to the transmit variolosser and the hybrid coil.

B. Receive Channel Circuits

Receive Variolosser

3.10 The receive variolosser is contained in CP6. It is a balanced shunt variolosser which provides 21 dB of insertion loss when no direct current is flowing through the varistors. The insertion loss is increased to 64 dB when 1.5 mA of direct current is flowing.

Receive Amplifier

3.11 The receive amplifier is contained in CP6. This amplifier provides 68 dB of power gain. Series feedback at the input raises the input impedance of the amplifier so that the 5100-ohm resistor shunting the input presents a constant load to the receive variolosser.

Loudspeaker Amplifier

3.12 The loudspeaker amplifier is contained in CP2. This amplifier provides 14 dB of power gain and has a maximum output of 2 watts. Resistors R15 and R16 raise the input impedance so that R7 (FS1) provides the proper termination for the receive amplifier.

C. Control Circuits

Control Variolosser

3.13 The control variolosser (CP5) adjusts the transmit switching threshold under control of direct current from the NOGAD and switchguard circuits. This variolosser acts as a variable shunt to ground at the input of the control amplifier. Insertion loss is from 0 to 15 dB due to NOGAD current and from 0 to 50 dB due to switchguard current.

Control Amplifier

3.14 The control amplifier is contained in CP5. This amplifier includes a full-wave rectifier and time-constant circuit at its output. Direct current is supplied to the transmit and receive variolossers when the switching threshold is exceeded. The attack and release times of the circuit are nominally 22 ms and 120 ms, respectively.

NOGAD Amplifier

3.15 The NOGAD amplifier is contained in CP4. This amplifier includes a full-wave rectifier and time-constant circuit at its output. Direct current is supplied to the control variolosser. Maximum output current is 50 uA. The attack time of the circuit is nominally 3 to 4 seconds and the release time is very short. Thus, the circuit responds to steady noise but not to speech.

NOGAD Precharge Circuit

3.16 The NOGAD precharge circuit consists of a resistor and capacitor (R7 and C5 in CP1) connected in series to the positive side of the power supply rectifier and the common side of K1 relay contact 3. The break side of the contact is connected to ground so that the capacitor becomes charged when the hands-free circuits are inactive. When relay K1 operates, the make-contact connects the charged RC circuit to the control variolosser. This supplies an initial surge of current which raises the switching threshold and prevents room noise from falsely switching the control unit before the NOGAD circuit becomes fully charged.

Switchguard Amplifier

3.17 The switchguard amplifier is contained in CP5. The full-wave rectifier and time-constant circuit at the output supply current to the control variolosser in proportion to the loudspeaker signal level. The attack time of this circuit is nominally 22 ms. The release time is nominally 300 ms which allows for decay of reverberant energy. The maximum output current is 3 mA.

VOLUME Control

3.18 The VOLUME control consists of resistors R4 and R5 and potentiometer R6. As the control is increased for greater signal level, less quiescent current is driven through the transmit and receive variolossers. Thus, the quiescent gain of the receive channel is increased. Consequently a greater amount of loss will be switched from the transmit to receive channels during normal operation.

D. Miscellaneous Circuits

Power Supply

3.19 The power supply is contained in CP1. The full-wave rectifier is fed from transformer T3. The output of this rectifier is connected externally to the coil and a make-contact of relay K1. When relay K1 is operated the rectifier output is returned to the regulator and filter sections of the power supply. The rectifier output is also connected to the NOGAD precharge circuit and through resistor R6 to the handset lamp lead. The lamp supply is nominally 40 mA at 10 Vdc.

3.20 Regulation and filtering of the positive 15-volt supply are provided by diode CR5, transistors Q1 and Q2, and the associated circuitry. Filtering of the positive 30-volt supply is provided by transistors Q3 and Q4 and the associated circuitry. Lamp battery for the key lamps is supplied through R8. The lamp supply is nominally 40 mA at 10 Vdc. The 15-volt supply provides a nominal 60 mA. The regulation of the 30-volt supply is limited by transformer T3 and it provides 110 mA at 24 Vdc.

Hybrid Balance Circuit

3.21 The hybrid balance network consists of resistors R8 and R9, capacitor C7, and varistors RV3 and RV4. On short loops sufficient loop battery current passes through RV3 and RV4 so that the effective network consists of R8 only. On longer loops R9 paralleled with C7 becomes more important. Thus a small degree of automatic hybrid balancing takes place.

Public Address Output

3.22 The outputs of the transmit and receive channels are combined at T1 (CP2) after approximately 40 dB of attenuation. The impedance level at the output is 600 ohms.

TOUCH-TONE Click Suppression

3.23 Varistors RV1 and RV2 suppress clicks from the TOUCH-TONE dial from an external telephone set.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

None.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

3.01 Conference communication using one of three microphones and a loudspeaker. Adjustment of loudspeaker signal level.

3.02 Handset communication using a TRIMLINE handset.

3.03 Transfer between hands-free and handset or vice versa during a conversation.

3.04 Voice-operated switching of loss to the idle channel.

3.05 One-way communication using the loudspeaker only.

3.06 Means to provide audible TOUCH-TONE signals through the loudspeaker from an external telephone set.

3.07 Means to connect both the transmitted and received signals to a public address system.

3.08 Lighted key lamps to indicate mode of operation.

4. CONNECTING CIRCUITS

None.

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