

STATION SYSTEMS  
50A1 CONFERENCE SET  
(73B CONTROL UNIT)  
CIRCUIT

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## 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 DESCRIPTION1. 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 two make-contacts to provide the following functions:

- (a) Connect the control unit microphone to the hands-free circuits.
- (b) Connect ground to relay K1 through closed contacts of the switchhook and the OFF key; relay K1 operates.

## 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 to lamp DS1.
- (c) Provides a lockup path that 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 variolossor.

(f) Connects the ring lead of the telephone line to the ring terminal of the AUX DIAL jack.

(g) When in 2-wire mode, provides a short for A-lead control across the T1 and R1 leads of the telephone plug.

(h) When in 4-wire mode, connects the T1 and R1 leads to the receive channel of the hands-free circuits.

## 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 two 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.

D. Providing Local Privacy

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

- (a) Connect ground to relay K1 through closed contacts of the switchhook and the OFF key.
- (b) Disconnect the output of the pre-amplifier and short the inputs of the control amplifier, the transmit variolossor, and the noise guard circuits.

### 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 normally closed switch contacts on J3 open and allow individual connection to the tip, ring, and sleeve of the plug. The AUX DIAL button operates a locking key with one make-contact and one set of transfer contacts to provide the following functions:

- (a) Connect ground to relay K1 through closed contacts of the switchhook and the OFF key.
- (b) Simultaneously disconnect the hybrid coil and connect the tip contact of J3 to the tip side of the telephone line.

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 Any one of the following combinations of locking keys can be operated at one time:

- (a) Any one key individually.
- (b) Any combination of the three microphone selection keys.
- (c) Any combination of the three microphone keys plus the MIKES OFF key for mikes off operation.
- (d) MIKES OFF and AUX DIAL keys.

### 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 from the receive channel is typically -45 dBV depending on the setting of the VOLUME control. The level obtained from the transmit channel is controlled by the setting of potentiometer R25 and is typically -45 dBV with R25 rotated to its maximum clockwise position. The PA output provides a balanced 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.
- (e) Removes the ring lead of the telephone line from the ring terminal of the AUX DIAL jack.
- (f) When in 2-wire mode, removes the short from the T1 and R1 leads.
- (g) When in 4-wire mode, disconnects the T1 and R1 leads from the receive channel of the hands-free circuits.

### 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.

### J. 4-Wire Operation

1.18 The control unit may be switched from 2-wire to 4-wire mode of operation by rotating switch S4 clockwise. This switch has four sets of transfer contacts to provide the following functions:

- (a) Disconnect the receive channel from the hybrid coil and connect it to the R1 and T1 leads of a 4-wire network.
- (b) Terminate the receive leg of the hybrid coil.
- (c) Remove the short circuit from across the T1 and R1 leads. This is normally provided for A-lead control when in the 2-wire mode.

## 2. DESCRIPTION OF EQUIPMENT

### 73B CONTROL UNIT

2.01 The 73B 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 jack for connecting the handset cord is attached to the side of the base pan. 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 to be used as an auxiliary dial. Also mounted on the back face is a potentiometer for adjusting the signal level from the transmit channel to the PA output terminals.

2.04 A set of four screw terminals is located on the bottom of the unit. One pair of terminals is provided for connecting to a public address system and the other pair of terminals, strapped together by a shorting link, is used for disconnecting the internal loudspeaker by removing the link.

2.05 A 2-position rotary switch used to select either the 2-wire or 4-wire mode of operation is located within the unit and is accessible by removing the gray cover.

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

#### MICROPHONES

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

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

#### LOUDSPEAKER

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

#### CARRYING CASE

2.10 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 that provide the necessary gain in

the transmit and receive channels. The transmit channel consists of the microphone, two amplifiers, and the transmit variolossers. The receive channel consists of two amplifiers, the receive variolossers, 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 variolossers. When the set is in the transmit state, the loss is present in the receive variolossers.

##### B. Control Circuits

3.03 When the local speech level exceeds the switching threshold, loss is removed from the transmit variolossers and inserted into the receive variolossers. This switching of states is accomplished by the direct current output of the control amplifier that 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. When adjusted to the zero receive volume setting, the unit is switched fully into the transmit state.

#### 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 response that approximates 1.5 dB per octave up to 1200 Hz and then exhibits a peaking characteristic at 3000 Hz, which is approximately 8 dB above the 1000-Hz response. This characteristic provides good intelligibility while reducing unwanted reverberant energy.

Transmit Variolosses

3.08 The transmit variolosses is contained in CP3. It is a balanced series variolosses that 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 variolosses and the hybrid coil.

B. Receive Channel CircuitsReceive Variolosses

3.10 The receive variolosses is contained in CP6. It is a balanced shunt variolosses that 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 receiver 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 variolosses.

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 R23 and R24 raise the input impedance so that R7(RS1) provides the proper termination for the receive amplifier.

C. Control CircuitsControl Variolosses

3.13 The control variolosses (CP5) adjusts the transmit switching threshold under control of direct current from the NOGAD and switchguard circuits. This variolosses 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 variolosses 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 variolosses. 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 6. 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 variolosses. This supplies an initial surge of current that 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 variolosses 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 resistor R5 and potentiometer R6. As the control is increased for greater output level, less quiescent current is driven through the transmit and receive variolosses. 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. When adjusted to the zero receive volume setting, the unit is switched full into the transmit state.

D. Miscellaneous CircuitsPower 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 lamp DS1 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 T3 to provide a balanced 600-ohm output. The levels of the transmit and receive channels appearing at the PA output terminals are controlled by potentiometer R25 and volume control R6, respectively.

#### 4-Wire Operation

3.23 In the 4-wire mode, transformer T2 is connected through resistors R10, R11, R14, and R15 to T1 and R1 leads when the hands-free circuits are energized. This connection is used for the receive channel of a 4-wire network. The transmit channel is connected to T1 and R1 leads. Resistor R13 is connected to the receive leg of the hybrid coil to maintain proper hybrid balance.

#### A-Lead Control Circuit

3.24 A make-contact on the K1 relay provides the required closure for A-lead control when the unit is connected to a key telephone system. The A and A1 leads from the key system must be connected to the T1 and R1 leads. When using the handset, a make-contact on the switchhook supplies the closure across T1 and R1 for A-lead control.

#### TOUCH-TONE Click Suppression

3.25 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 Provides conference communication using any combination of three microphones and a loudspeaker. Adjustment of loudspeaker signal level.

3.02 Provides handset communication using a TRIMLINE handset.

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

3.04 Provides voice-operated switching of loss to the idle channel.

3.05 Provides one-way communication using the loudspeaker only.

3.06 Provides for TOUCH-TONE signaling from an external telephone set equipped with either an RC or LC dial.

3.07 Connects both the transmitted and received signals to a public address system and adjusts the relative balance between them.

3.08 Provides a lighted key lamp in the OFF button which illuminates the word ON to indicate when the hands-free circuits are energized.

#### 4. CONNECTING CIRCUITS

None.

#### 5. MANUFACTURING TESTING REQUIREMENTS

5.01 This circuit shall be capable of performing all the functions specified in 3. FUNCTIONS and meeting all the requirements of the Circuit Requirements Table.

### SECTION IV - REASONS FOR REISSUE

#### B. Changes in Apparatus (Components)

B.1 In FS1, App Fig. 1:

<u>Removed</u>	<u>Replaced by</u>
R26 Resistor - KS-13490, L1, 82 kilohms	R26 Resistor - KS-13490, L1, 18 kilohms

R10 Resistor -  
KS-13491, L1, 24  
ohms

R10 Resistor -  
KS-13490, L1, 24  
ohms

Added

W5 Cord D4BU,  
Adaptor 225-A

R11 Resistor -  
KS-13491, L1, 24  
ohms

R11 Resistor -  
KS-13490, L1, 24  
ohms

D. Description of Changes

D.1 This reissue is made to revise the  
circuit description.

D.2 The title has been changed to read:

STATION SYSTEMS  
50A1 CONFERENCE SET  
(73B CONTROL UNIT)  
CIRCUIT

Added

DS2 Lamp - 51B

B.2 In CPS2:

Removed

Replaced by

R14, R16, R17  
Resistors - 237A,  
1 ohm

R14, R16, R17  
Resistors -  
KS-20616, L1A, 1 ohm

Added

C21 Capacitor - KS-16958, L32, 24.3 pF

B.3 In FS1:

D.3 In FS1, the following connector des-  
ignations are changed to agree with We manu-  
facturing drawings: J4 to J12, J7 to J4, J12  
to J5, P8 to P7, and P10 to P14.

D.4 Equipment Note 202 is modified to  
include the 220A handset as part of the  
shipped product.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 3325-JAD-FEF

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