ECHO SUPPRESSION AND ANTI-SING CIRCUIT SD-1G283-01 IDENTIFICATION, INSTALLATION, CONNECTIONS, AND LINE-UP PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section contains identification, installation, connection, and line-up information for the Echo Suppression and Anti-Sing (ESAS) circuit SD-1G283-01.

Purpose of Circuit

1.02 This circuit provides a voice-operated gain switching repeater for multipoint 4-wire private line networks. It suppresses talker echo and provides singing protection when the 4-wire line is connected to a 2-wire termination.

General Description of Operation

1.03 The ESAS circuit is typically installed in the 4-wire transmission path between a switching system and a 4-wire to 2-wire hybrid termination where 2-wire access is required. Because of poor return losses at the 2-wire junction, a portion of the received signal is retransmitted as an echo. For short haul circuits this echo blends with the normal sidetone at the far end station and is usually not objectionable. For long haul circuits the echo is delayed sufficiently to be objectionable. Furthermore, because of the poor return losses encountered, singing may occur if more than two 2-wire connections are added to a 4-wire conference connection.

1.04 A solid-state switched gain amplifier (SGA) is used to control an auxiliary echo suppression (ES) relay circuit to function in a manner similar to a standard split echo suppressor. The voice-operated gain switching produces the anti-singing feature.

2. IDENTIFICATION

2.01 One J1G024D-1 Echo Suppression and Anti-sing unit (Fig. 1) consists of assembly, equipment, and surface wiring occupying space of one 2 by 23-inch mounting plate.

2.02 The J1G024D-1 unit contains the following plug-in units:

- One J68657AA-1 Switched Gain Amplifier (part of SD-5G099-01)
- One CP1 (ED-1G180-) Auxiliary Control
- One CP2 (ED-1G239-) Signal Detector.

Switching System Transmission Characteristics—Application

2.03 The ESAS circuit is designed for use with 600-ohm connecting circuits and with systems having a minimum return loss of 20 dB, such as the echo cancellation legs of the No. 304 Switching System. Other conferencing arrangements, such as 4-wire, 4-way or 4-wire, 6-way bridges, are also satisfactory.

2.04 Switching systems having zero return loss, such as the No. 306 and 310 Switching Systems, require the use of the Switched Gain Echo Suppression (SGES) circuit SD-1G240-01 (J1G022AP) for use with zero return loss circuits.

2.05 A restriction applies to the hybrid arrangement used; for a minimum of 20 dB, transhybrid

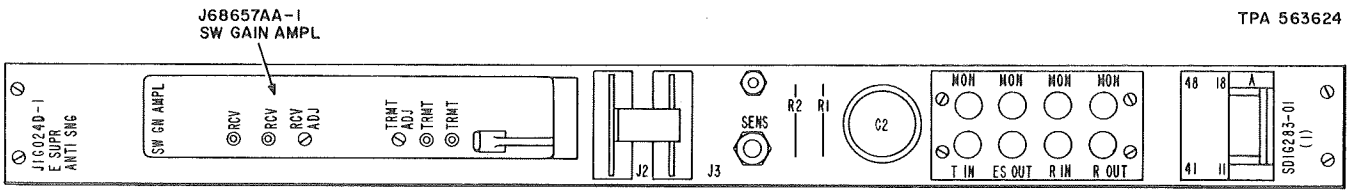


Fig. 1—J1G024D-1 Echo Suppression and Anti-Sing Unit

loss must be maintained for all 2-wire connections which use the ESAS. If necessary, build-out pads may be inserted in the 4-wire connection to meet this requirement.

2.06 Typical recommended circuit configurations are indicated in Fig. 2, 3, and 4.

2.07 Optimum speech levels for balanced break-in characteristics are −20 vu input to the TRANSMIT amplifier and −10 vu input to the RECEIVE amplifier (3.06); but variations of as much as 10 dB in the speech signal do not seriously affect the performance of the ESAS circuit.

2.08 Fig. 5 indicates relative test levels suitable for use with a switching system having an input and output at −8 TLP, which corresponds to a speech level of −19.5 vu ±1.5 dB for the average talker. The −8 TLP means that at some point in the system a transmission level (for example, 0 dBm) is denoted as the "reference" level; and that at the point denoted by −8 TLP the transmission level is specified to be "down" by 8 dB or −8 dB from that reference transmission level point.

2.09 This echo suppression circuit is designed for use in ***dry*** 4-wire transmission circuits and does not include any signaling apparatus. It is assumed that the line circuit of the associated switching system will include all signaling equipment for E and M lead or DX signaling control.

2.10 This circuit includes apparatus and wiring options which permit operation from either −24 volt or −48 volt talk battery supplies. On −24 volt talk battery supply, option Z, the ***nominal*** current is 205 milliamperes. On −48 volt talk battery supply, option Y, the ***nominal*** current is 200 milliamperes.

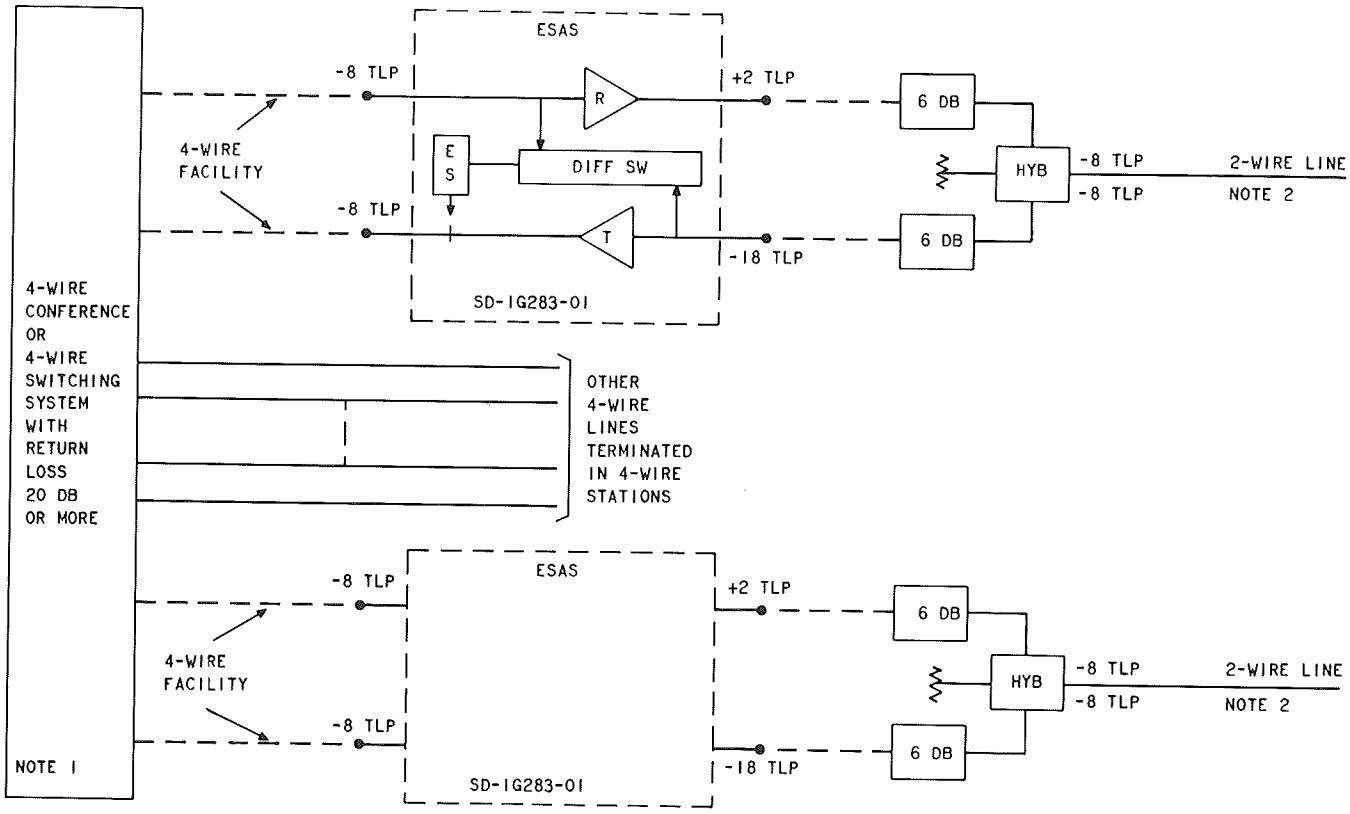
2.11 Circuit design features of the ESAS are described in CD-1G283-01.

2.12 Equipment design requirements of the ESAS are described in Section 811-016-150.

3. OPERATION

3.01 The ESAS circuit provides voice-switched gain of amplifiers to improve the singing margin and a voice-switched reed-type ES relay to achieve echo suppression in a 4-wire transmission path.

3.02 Briefly, when ***no*** speech is present from either direction the SGA part of the ESAS circuit inserts a 15 dB loss in the return path toward the 4-wire switching system and 0 dB gain in the outgoing path. ***Outgoing*** speech from the 4-wire switching system does not affect the switched-gain status of the SGA; ie, 15 dB loss in return path and 0 dB gain in outgoing path. However, the outgoing speech causes the voice-switched ES relay to operate. When the ES relay operates, it "opens" the return path toward the 4-wire switching system and terminates each end of the open transmission path in 600 ohms. This effectively provides a return ***loss*** greater than 60 dB. When outgoing speech ceases, the ES relay releases. ***Incoming*** speech originating from the 2-wire station (via a 2-wire: 4-wire hybrid) ***reverses*** the switched-gain status of the SGA to insert 15 dB loss in the outgoing path from the 4-wire switching system and 0 dB gain in the incoming path. When incoming speech ceases, the SGA switches back to ***normal;***



NOTES:
1. CONNECTING CIRCUITS-
   304 SWITCHING SYSTEM (ECHO TREATED):
   4-WIRE LINE CIRCUIT, SD-1G155-01
   4-WIRE LINE CIRCUIT, SSI SEL SIG, SD-1G170-01
   4-WIRE CO LINE CIRCUIT, SD-1G188-01
   4-WIRE NO.5 CROSSBAR SWITCHING SYSTEM:
   AUXILIARY LINE CIRCUIT, SD-27738-01
   4-WIRE ESS OFFICE:
   UNIVERSAL COUPLER, SD-2A014-01
   TOLL SYSTEMS:
   44 AND 46-TYPE BRIDGE CIRCUITS, SD-55647-01 (TYPICAL)
2. CONNECTING CIRCUITS-
   304 SWITCHING SYSTEM (ECHO TREATED):
   2-WIRE PBX OR CO LINE CIRCUIT, SD-1G156-01
   COMMON SYSTEMS:
   V4 TELEPHONE REPEATER, SD-97047-01
   4-WIRE TERMINATING CIRCUIT, SD-97138-01

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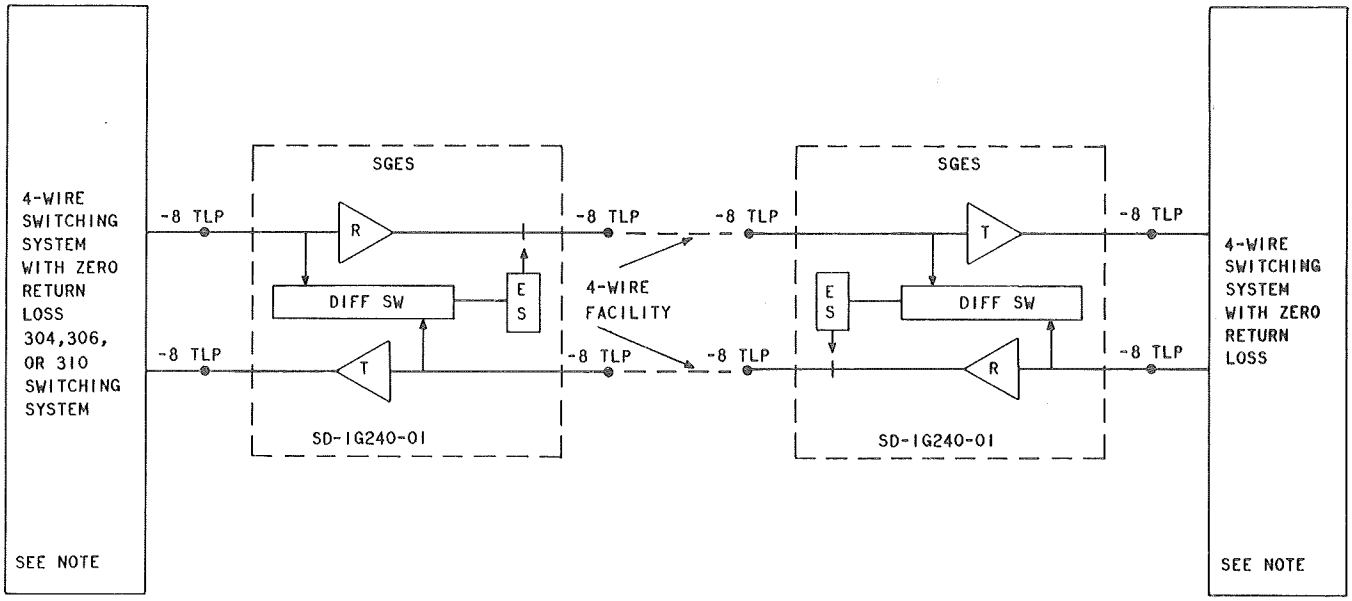
Fig. 2—Typical Circuit Application Using ESAS Unit SD-1G283-01

ie, 15 dB loss in return path and 0 dB gain in outgoing path.

3.03 The SGA (Fig. 6) contains two ***transmission*** amplifiers (T and R), one for each direction, whose gains are under control of a differential switch. Two ***control*** amplifiers (T′ and R′) are also provided, each one monitoring speech in one direction, and their outputs are rectified and combined to control the state of the differential switch.

3.04 A noise-operated gain-adjusting device (NOGAD) is incorporated in the SGA unit to prevent lock-up of the differential switch to steady line noise (originating from the 2-wire direction). This is accomplished by a slow-charge fast-discharge circuit which differentiates between syllabic signals and steady line noise. If a sufficient



NOTE:
CONNECTING CIRCUITS-
304 SWITCHING SYSTEM (NON-ECHO TREATED):
4-WIRE LINE CIRCUIT, SD-1G155-01
306 SWITCHING SYSTEM:
RESIDENCE LINE CIRCUIT, SD-1G195-01
310 SWITCHING SYSTEM:
4-WIRE LINE CIRCUIT, SD-1G235-01
4-WIRE LINE CIRCUIT, SSI SIG, SD-1G236-01

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Fig. 3—Typical Circuit Application For Interconnecting Two Zero Return Loss Switching Systems Using SD-1G240-01

noise is present, it is rectified by the NOGAD and used to decrease the sensitivity of the differential switch by a corresponding amount.

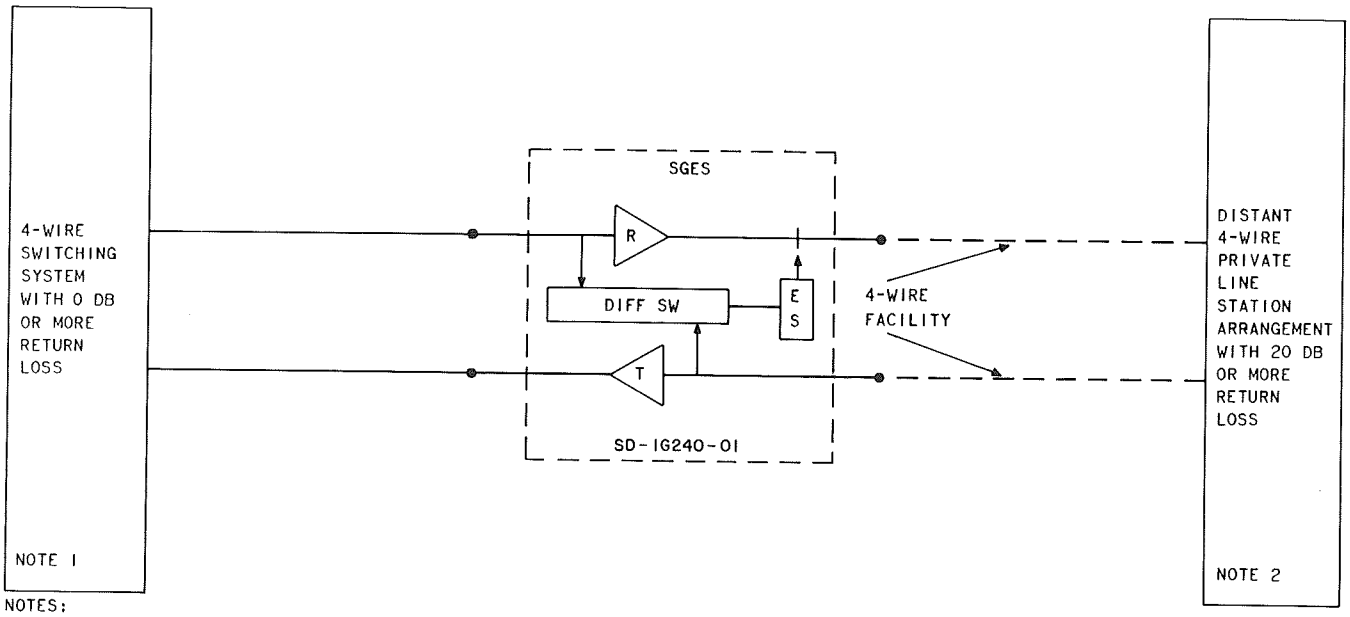
3.05 The differential switch is biased to return to a predetermined state in the ***absence*** of speech in both directions (3.07), or in the ***presence*** of controlling speech from the 4-wire switching system (3.08).

3.06 In the ESAS circuit application of the SGA, ***outgoing*** speech originating from the 4-wire switching system appears at the input of the RECEIVE amplifier. ***Incoming*** speech originating from the 2-wire station appears at the input of the TRANSMIT amplifier.

3.07 When speech is absent at both inputs (Fig. 7), the differential switch in the SGA remains in its ***normal*** state, which inserts 15 dB of loss in the TRANSMIT amplifier and no loss in the RECEIVE amplifier. At the same time, the differential switch produces a negative control voltage on pin 13 of the SGA connector, which prevents operation of the ES relay in CP1. As long as the ES relay remains nonoperated, the incoming speech path is completed from the 2-wire station to the 4-wire switching system with 15 dB of loss, while the outgoing speech ***path*** is at full gain.

3.08 When speech originates at ***any*** of the stations from the 4-wire switching system, the differential switch in the SGA remains in its ***normal*** state which inserts 15 dB of loss in the TRANSMIT amplifier and no loss in the RECEIVE amplifier; ***except*** that the RECEIVE speech detecting part of the SGA produces an (audio) ac output on pin 19 of the SGA connector. This causes the ES relay to operate, ***opening*** the output path of the TRANSMIT amplifier toward the switching system so that no significant (echo) signal can return (Fig. 8).

3.09 The signal detector unit, CP2, ***extends*** the hangover time of the ES relay for about 50 milliseconds after speech originating from the 4-wire switching system disappears to prevent



NOTES:

1. CONNECTING CIRCUITS-
   - 4-WIRE SWITCHING SYSTEM WITH 0 DB RETURN LOSS
     - 304 SWITCHING SYSTEM (NON-ECHO TREATED):
       - 4-WIRE LINE CIRCUIT, SD-1G155-01
     - 306 SWITCHING SYSTEM:
       - RESIDENCE LINE CIRCUIT, SD-1G195-01
     - 310 SWITCHING SYSTEM:
       - 4-WIRE LINE CIRCUIT, SD-1G235-01
       - 4-WIRE LINE CIRCUIT, SSI SIG, SD-1G236-01
   - 4-WIRE SWITCHING SYSTEM WITH AT LEAST 20 DB RETURN LOSS
     - 304 SWITCHING SYSTEM (ECHO TREATED):
       - 4-WIRE LINE CIRCUIT, SD-1G155-01
       - 4-WIRE LINE CIRCUIT, SD-1G170-01
       - 4-WIRE CO LINE CIRCUIT SD-1G188-01
     - 4-WIRE NO.5 CROSSBAR SWITCHING SYSTEM:
       - AUXILIARY LINE CIRCUIT, SD-27738-01
     - 4-WIRE ESS SWITCHING SYSTEM:
       - UNIVERSAL COUPLER, SD-2A014-01
     - TOLL SYSTEMS:
       - 44 AND 46 TYPE BRIDGE CIRCUITS, SD-55647-01 (TYPICAL)
2. CONNECTING CIRCUITS-
   - 4-WIRE PRIVATE LINE STATION ARRANGEMENTS
     - STATION SYSTEMS:
       - 4-WIRE PRIVATE LINE CIRCUIT, SD-69410-01
       - 4-WIRE PRIVATE LINE CIRCUIT, SD-69449-01
       - 4-WIRE SUBSCRIBER LINE CIRCUIT, SD-69488-01
       - 4-WIRE PRIVATE LINE TERMINATION AND STATION CIRCUIT, SD-69566-01
   - DISTANT 4-WIRE SIX-WAY BRIDGE ARRANGEMENTS
     - TOLL SYSTEMS:
       - 44 AND 46 TYPE BRIDGE CIRCUITS, SD-55647-01 (TYPICAL)

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Fig. 4—Typical Circuit Application For Full 4-Wire Systems Using SD-1G240-01

switching at a syllabic rate. This hangover time also protects against echoes appearing from the 2-wire circuit which might be delayed as much as 50 milliseconds.

3.10 Should speech reply from the 2-wire station occur before the ES relay 50 millisecond hangover time terminates, then speech from the 2-wire station ***cancels*** this hangover time within 4 milliseconds.

3.11 When speech originates at the 2-wire station, the differential switch in the SGA ***operates*** to remove the 15 dB of loss from the TRANSMIT amplifier, which allows the speech signals to enter the switching system at the normal level. The

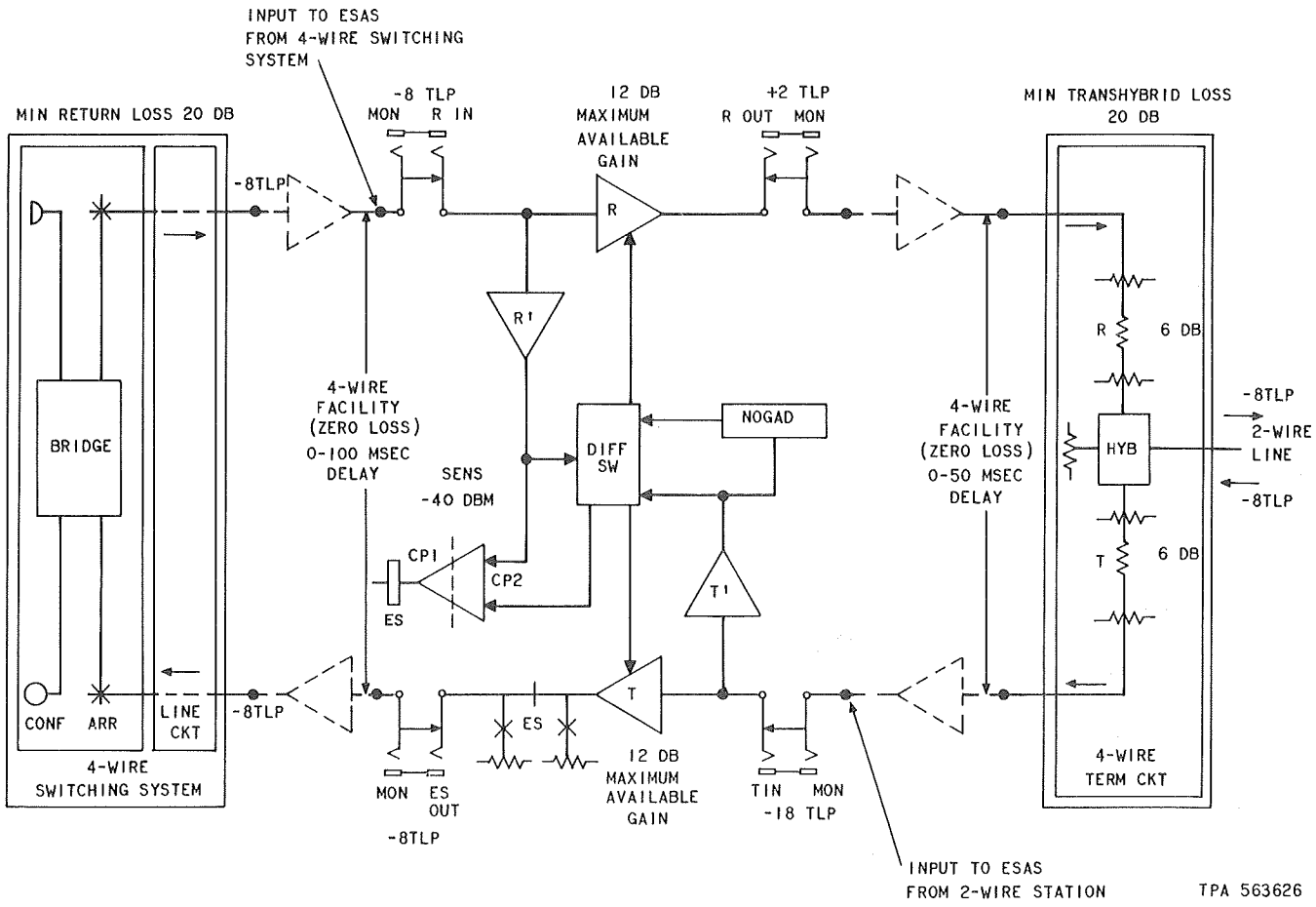

Fig. 5—Simplified Schematic of Echo Suppression and Anti-Sing Circuit SD-1G283-01—Typical Application Levels

differential switch, at the same time, removes the negative control voltage from pin 13 of the SGA connector. This cancels any hangover time of the ES relay to ensure its quick release. The differential switch also inserts 15 dB of loss in the RECEIVE amplifier to maintain the singing margin (Fig. 9).

3.12 The time constants of the differential switch are chosen for a hangover time of 125 milliseconds after speech originating from the 2-wire station disappears before the switch restores to ***normal.***

3.13 Should speech reply from the 4-wire switching system occur before the differential switch 125 millisecond hangover time terminates, then speech from the 4-wire switching system ***cancels*** this hangover time within 4 milliseconds.

3.14 In effect, the gain switching in the SGA is under control of voice signals originating at the 2-wire station, and the echo suppression relay is under control of voice signals originating from the 4-wire switching system.

3.15 When speech originates from ***both*** the 2-wire station and the 4-wire switching system simultaneously, the hangover time of the echo suppression circuit (3.09) ***and*** the hangover time of the differential switch (3.12) are ***both canceled.*** Then ***control shifts rapidly*** to the input signal that is momentarily stronger. Some mutilation of the speech is to be expected when this happens.

4. INSTALLATION

4.01 The J1G024D-1 Echo Suppression and Anti-sing unit is shipped complete with the J68657AA-1

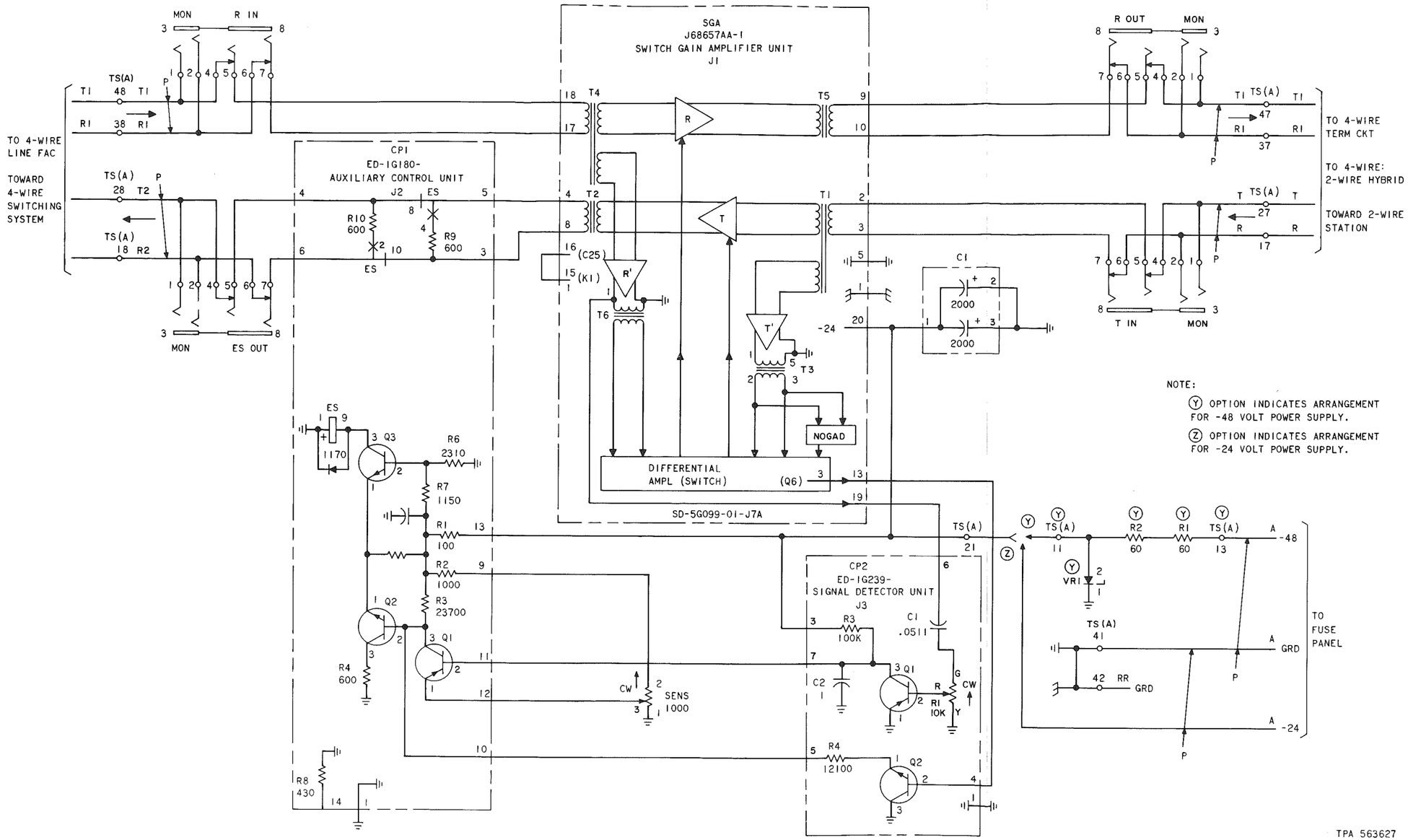

Fig. 6—Simplified Schematic of Echo Suppression and Anti-Sing Circuit SD-1G283-01—Functions and Connections

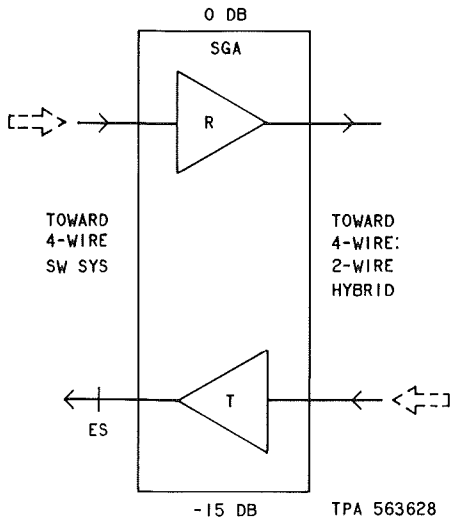

Fig. 7—ESAS—No Speech in Either Direction

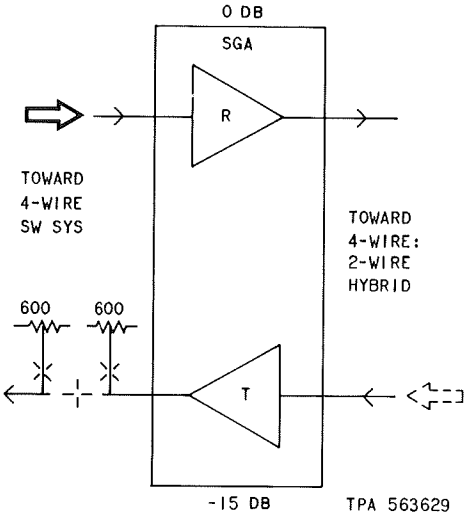

Fig. 8—ESAS—Speech Toward 4-Wire: 2-Wire Hybrid

SGA unit, the CP1 ED-1G180—Auxiliary Control circuit pack, and the CP2 ED-1G239—Signal Detector circuit pack.

4.02 The ESAS unit is arranged for frame mounting in standard 23-inch relay frames.

4.03 These units are usually hard-wired directly to other type units with which they are associated in the transmission system.

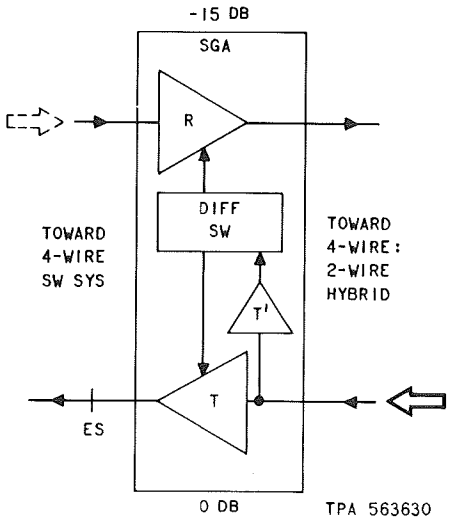

Fig. 9—ESAS—Speech Toward 4-Wire Switching System

4.04 No ***special*** tools are needed for installing this unit.

4.05 The ESAS unit must be mounted in the standard position because of the orientation requirement of the 330A (ES) relay. The relay (in SGA unit) must be operated in a vertical position with "TOP" appearing on the upper surface.

4.06 The proper wiring option for the power supply to be used with, either −24 volts (option Z), or −48 volts (option Y) must be properly strapped on TS(A) of the ESAS unit. Refer to Fig. 6 for connections.

5. CONNECTIONS

5.01 Connections are shown in Fig. 6 and 10.

6. LINE-UP PROCEDURES

6.01 Gain adjustments for the TRANSMIT and RECEIVE amplifiers may vary according to the particular application. Deviations from the standard lineup should be indicated by information notes on the associated SD- for the system with which the ESAS circuit is used.

6.02 ESAS circuit adjustments should only be made after all switching system adjustments have been completed.

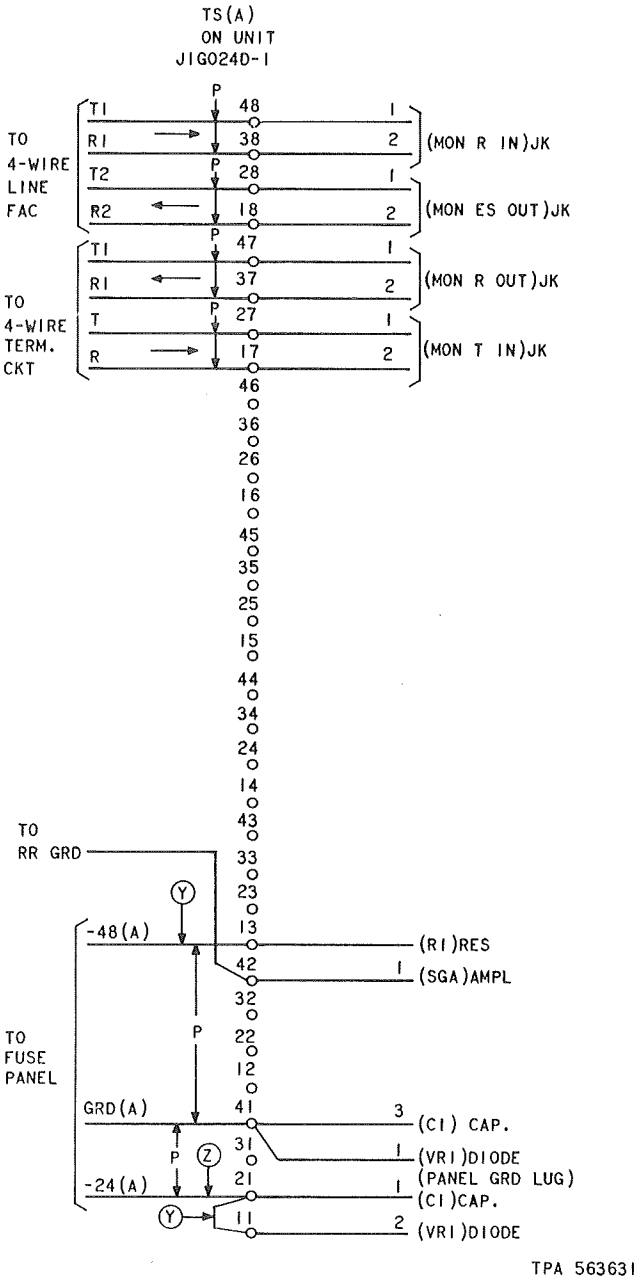

Fig. 10—J1G024D-1 Unit—Connections

6.03 The following test equipment is required:

(a) One 21A Transmission Measuring Sets (TMS), or equivalent

(b) One ohmmeter to differentiate between 90 and 600 ohms

(c) Voltmeter, DC

(d) Test cords terminating in 310 plugs at the end which connects to the ESAS under test or line-up

(e) One 165 dummy plug, or equivalent.

6.04 Prior to making the ESAS line-up, the associated line must be made maintenance-busy.

6.05 To line-up the ESAS, perform the following steps.

A. Transmit Gain Adjustment

6.06 To adjust the transmit gain, perform Steps (1) through (9).

(1) Adjust the 21A TMS OSC OUT for 1000 Hz and −18 dBm, as measured on the 600-ohm 21A TMS detector, or equivalent.

(2) On the J1G024D-1 ESAS unit to be adjusted, perform Steps (3) through (9).

(3) Connect 21A TMS OSC OUT jack to associated T IN jack.

(4) Connect 21A TMS DET IN jack to associated ES OUT jack.

(5) Insert the 165 dummy plug into the R IN jack.

(6) On the front panel of the SGA (Fig. 1)—Adjust the TRMT ADJ potentiometer so that 21A TMS detector indicates −8 dBm.

(7) Remove 21A TMS DET IN test cord plug from ES OUT jack.

(8) Remove 21A TMS OSC OUT test cord plug from T IN jack.

(9) Remove the 165 dummy plug from R IN jack.

B. Receive Gain Adjustment

6.07 To adjust the receive gain, perform Steps (10) through (18).

(10) Adjust the 21A TMS OSC OUT for 1000 Hz and −8 dBm, as measured on the 600-ohm 21A TMS detector, or equivalent.

(11) On the J1G024D-1 ESAS unit to be adjusted, perform Steps (12) through (18).

(12) Connect 21A TMS OSC OUT jack to associated R IN jack.

(13) Set 21A TMS to read a +2 dBm signal. (Set 21A TMS DET INPUT switch to +10.)

(14) Connect 21A TMS DET IN jack to associated R OUT jack.

(15) Insert the 165 dummy plug into the T IN jack.

(16) On the front panel of the SGA (Fig. 1)—Adjust the RCV ADJ potentiometer so that 21A TMS detector indicates +2 dBm.

(17) Remove 21A TMS DET IN test cord plug from R OUT jack.

(18) Leave 21A TMS OSC OUT test cord plug in R IN jack and the 165 dummy plug in T IN jack for echo suppression sensitivity adjustment.

C. Echo Suppression Sensitivity Adjustment

6.08 To adjust echo suppression sensitivity, perform the following:

(19) On the J1G024D-1 ESAS unit to be adjusted, or on the 21A TMS as required, perform Steps (20) through (31).

(20) Set the SENS control, located centrally on the mounting plate (Fig. 1) to midrange.

(21) Carefully set potentiometer (R1) of CP2 fully clockwise.

(22) Connect the positive lead of the voltmeter (6.03c) to ground and the negative side to pin 7 of J3 which is the top pin of the connector for CP2.

(23) Connect the ohmmeter (6.03b) to the ES OUT jack; it should indicate either 90 or 600 ohms, depending on the state of the ES relay.

Note: The following applies to Steps 24 and 25: To change the ohmmeter indication from 600 ohms to 90 ohms, ***decrease*** the 21A TMS OSC OUTPUT.

To change the ohmmeter indication from 90 ohms to 600 ohms, ***increase*** the 21A TMS OSC OUTPUT.

(24) Carefully vary the 21A TMS OSC OUTPUT and observe the point at which the ohmmeter reading changes. The word "changes" means that if the ohmmeter indicated either 90 or 600 ohms, it would abruptly change to 600 ohms or to 90 ohms, respectively. This indicates operation or release of the ES relay.

Also, note the DC voltmeter reading ***when*** the "change" occurs in the ohmmeter reading.

(25) Alternately and gradually change the SENS control setting ***and*** the 21A TMS oscillator output level control until the "change" in ohmmeter reading occurs at a voltmeter reading of −2.0 volts.

(26) Lock the SENS control and disconnect the voltmeter.

(27) Readjust the oscillator output level control to the desired echo suppression sensitivity. A typical sensitivity is −40 dBm when the R IN jack is at a −8 TLP.

(28) Turn the adjusting screw of R1 on CP2 counterclockwise until a "change" in ohmmeter reading occurs, indicating operation, or release, of the ES relay.

(29) Remove the 165 dummy plug from T IN jack.

(30) Remove the 21A TMS OSC OUT test cord plug from R IN jack.

(31) Remove the ohmmeter test cord plug from ES OUT jack.

7. MAINTENANCE

7.01 Operation of this circuit (if strapped for −48 volts, option Y) with any of the plug-in boards removed for a prolonged period of time should be avoided to prevent excessive heat dissipation in VR1 (Fig. 6). This can be prevented by removing the −48 volt fuse which supplies power to the unit. (The absence of −48 volts on

TS(A) 13 with respect to TS(A) 41 would verify that the correct fuse had been removed.)

7.02 Three internal potentiometer adjustments (in the SGA) are set at the factory and should not be readjusted in the field. Units must be returned to a Western Electric distributing house for readjustment if these internal potentiometers are disturbed.

7.03 The J1G024D-1 ESAS unit employs plug-in printed wiring boards to facilitate maintenance. Test jacks provide easy access to the transmission paths for line-up and testing.