820A (J87822) RINGING, TONE, AND INTERRUPTER PLANT THEORY

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1. GENERAL

INTRODUCTION

1.01 This section provides information for telephone company personnel to obtain a better understanding of how the 820A Ringing, Tone, and Interrupter Plant operates in an ESS environment. Table A provides a list of abbreviations and acronyms with applicable terms used in this section.

TABLE A

ABBREVIATIONS AND ACRONYMS

ABBREVIATION	TERM
BT	Busy Tone
CAMA	Centralized Automatic Message Accounting
CC	Central Control
ESS	Electronic Switching System
HT	High Tone
IPM	Interruptions Per Minute
OBAT	International Operator Bridged Access Interoffice Trunk
ROTL	Remote Office Test Line
SD	Signal Distributor
TPT	Test Progress Tone
TSI	Time Slot Interchange

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph. The Equipment Test List is not affected.

1.03 This section explains the following:

- Frame interfaces with other No. 4 ESS equipment
- How the frame signal and control circuits and power and alarm circuits perform their functions.

1.04 This issue of the section is based on the following schematic drawings (SDs):

SD-82157-01, Issue 5 B—Ringing, Tone, and Signal Circuits, 820A Ringing, Tone, and Interrupter Plant (J87822A)

SD-81975-01, Issue 4—Inverter Circuit, 20-Hz, 86-Volt, 0.25 ampere (J87337A)

SD-82156-01, Issue 9 —Ringing, Tone, and Signaling Circuits, General Use Circuit Packs

SD-81885-01, Issue 22—Signaling Circuit Pack Schematics

If this section is to be used with equipment or apparatus reflecting an earlier or later issue(s) of the SD(s), reference should be made to the SDs and circuit descriptions (CDs) to determine the extent of the changes and the manner in which this section may be affected.

PURPOSE OF THE 820A PLANT

1.05 The 820A plant (J87822A) operates from a -48 volt DC input and is designed to provide 0.25 ampere of continuous ringing current, continuous and interrupted call-progress tones, and interrupted loop signaling as required by No. 4 ESS toll offices.

820A PLANT CONFIGURATION

1.06 The fully equipped 820A plant consists of one equipment bay. The bay has duplicate inverters, tone generators, interrupters, follower relays, and monitors. The bay is divided into the "0" and "1" sides of the plant. Both sides of the plant are powered under normal operating conditions with only one side of the plant connected to the office load.

2. 820A PLANT INTERFACES

GENERAL

2.01 Figure 1 shows, in block diagram format, the interfaces between the 820A Ringing Tone, and Interrupter Plant and:

- The multifrequency signaling frame
- International operator bridged access interoffice trunk (OBAT)
- The voiceband interface frame or D4 channel bank
- The metallic terminal frame and auxiliary metallic trunk circuits
- The ***remote office test line frame (ROTL)***
- The signal processor 1, or signal processor 1 with combined distributor and scanner matrix, or signal processor 2
- The power distribution system
- The office alarm system
- The interrupter applique and switchboard.

SCAN POINTS AND SIGNAL DISTRIBUTOR POINTS

2.02 Communication between the 820A plant and the signal processor is accomplished via signal processor scan points and ***signal distributor (SD)*** points. The scan points from the 820A to the signal processor are used by ***central control (CC)*** to monitor the state of operation of the various units in the 820A plant. These scan points monitor the state of relays in the 820A plant. This monitoring information is sent to the CC from the signal processor. The CC processes this information and, by use of SD points from the signal processor, can control and change the state of the 820A plant by providing loop closures to the 820A plant.

2.03 The scan points from the 820A plant enable the CC to obtain the necessary information needed to monitor the operation of the plant. The signal processor accomplishes this function by periodically reading all scan points. The scan points can give the following types of indications:

- The voltage level of a tone output has fallen below a predetermined level
- A no-voltage condition exists at the output of the 20-Hz inverter
- Which inverter is supplying load
- If any part of the interrupter circuit fails
- Which side of the plant is supplying tones
- The power on/off state of both sides of the plant
- If a fuse alarm relay in either side of the plant is operated.

2.04 Central control uses the SD points of the signal processor to control and change the state of the 820A. The SD points permit the system to perform the following functions:

- Control plant transfer of tone distribution and plant loads
- Test the operation of all return path tone low voltage monitors
- Test operation of all monitors on "0" and "1" sides of the plant and ringing monitor on bus
- Transfer ringing loads from "1" side of plant to "0" side of plant.

SYSTEM TONE DISTRIBUTION

2.05 Tones are distributed and multiplied in the No. 4 ESS office by utilizing the unique properties of the ***time-slot interchange (TSI)*** circuitry in the TSI frame. The TSI eliminates the need for tone terminations on the switching network. All tone distribution is accomplished by program control of the dedicated TSI. For a detailed description on recorded announcement and tone distribution throughout the No. 4 ESS network, refer to the No. 4 ESS general description document, Section 234-100-000.

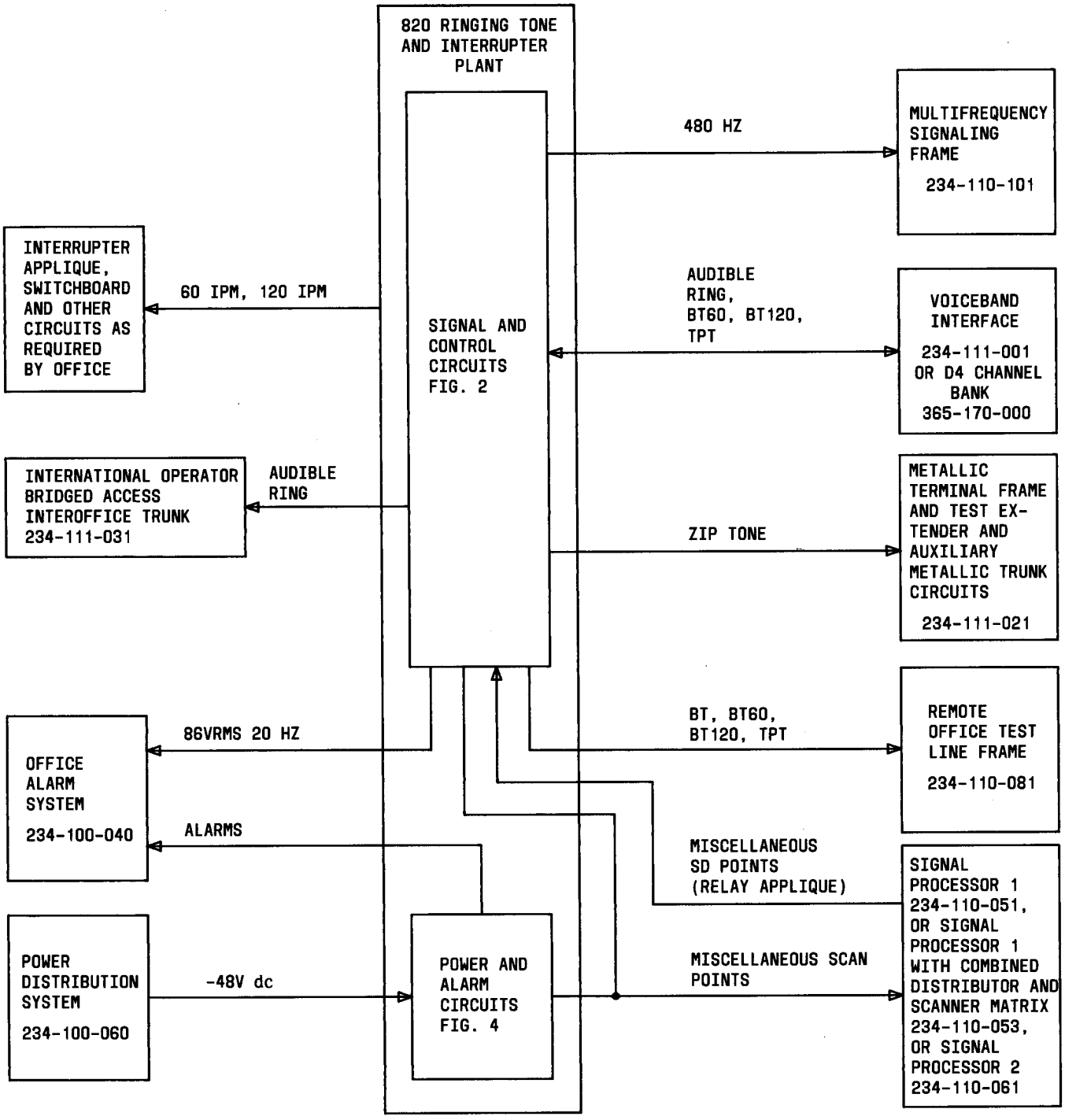

Fig. 1—820A Ringing, Tone, and Interrupter Plant—Functional Interface Diagram

SECONDARY INTERFACES OF THE 820A

2.06 A 480-Hz tone is supplied to the multifrequency signaling frame by the 820A plant in No. 4 ESS offices which have international calling. The tone is transmitted to a distant operator in the domestic network for originating an international call.

2.07 The 820A plant supplies the following three tones to the ROTL frame:

- BT at 60 ***interruptions per minute*** (IPM)
- BT at 120 IPM
- Test progress tone (TPT).

These tones are used by the ROTL frame for transmission trunk testing.

2.08 The metallic terminal frame and the auxiliary metallic trunk circuits are also supplied with a continuous 480-Hz tone by the 820A. The tone, also referred to as "zip tone", is used by the metallic terminal frame to indicate to the centralized automatic message accounting (CAMA) operators the status of calls.

2.09 In international switching centers, the ringing and tone plant applies an audible ring signal to the international operator who has access to the interoffice trunk.

2.10 Audible ring, busy tone, reorder tone, and test tone are supplied to the voiceband interface frame or D4 channel bank. These signals are converted from analog to digital and applied to the switching network. These signals are also returned via voiceband interface or D4 channel bank.

2.11 Although not illustrated in Fig. 1, the 820A plant also supplies audible ring to the mass announcement system frame. This interface is provided through the voiceband interface or D4 channel bank and a nailed-up connection through the No. 4 ESS switching network.

2.12 Alarm signals and 86 volts rms, 20-Hz ringing current are supplied to the office alarm system. The 86 volts rms is used as a backup for the alarm power supply in the office alarm system.

2.13 Interrupted loops are supplied to the interrupter applique, switchboard, and other circuits as required by the individual No. 4 ESS office. These interrupted loops are interrupted at 60 ipm and 120 ipm.

2.14 The ringing, tone, and interrupter plant receives its -48 volts dc power input from the power distribution system.

3. THEORY—SIGNAL AND CONTROL CIRCUITS

INTRODUCTION

3.01 The 820A ringing, tone, and interrupter plant supplies the No. 4 ESS with the outputs as shown in Table B. These outputs are generated by the signal and control circuit shown in Fig. 2.

3.02 Generation of these outputs is accomplished by the following functional circuits in the 820A:

- Tone supply
- Tone monitors
- J87337A inverters
- Interrupter circuit
- Tone distribution
- Control and transfer circuit.

TONE SUPPLY

3.03 Tones are generated internally in the 820A plant by four crystal-controlled oscillator circuit packs. The operation of each circuit pack is identical except that they are designed to oscillate at different frequencies. These four frequencies are 440, 480, 620, and 2225 Hz. The oscillators feed 1-VA amplifiers in different combinations of one or two of the basic frequencies.

TABLE B

820A OUTPUT SIGNALS		
OUTPUT	TYPE OF SIGNAL	FREQUENCY
Audible Ring (AR)	Tone	440 + 480 Hz
Busy Tone (BT)	Tone	480 + 620 Hz
High Tone *(HT)	Tone	480 Hz
Test Progress Tone (TPT)	Tone	2225 Hz
60 IPM	Interrupted Loop	60 IPM
120 IPM	Interrupted Loop	120 IPM
86 VRMS	AC-Sine Wave	20 Hz
*High Tone in some applications is referred to as Zip Tone.		

TONE MONITORS

3.04 Voltage sensing monitors are employed by the 820A plant to check the integrity of the following areas:

- Tone supply and return tones
- J87337A inverters
- Interrupter circuit.

For all except the J87337A inverters, the monitors check for a low-voltage condition. The J87337A inverters are continuously monitored for a no-voltage condition.

A. Tone Supply and Return Tone Monitoring

3.05 The outputs from the tone supply circuit are fed to the tone low-voltage monitors. Tone monitors are designated "forward path" or "return path." Forward path monitors detect the presence or absence of tones supplied by the plant. Return path monitors monitor tones returned from the voiceband interface frame or D4 channel bank.

3.06 The state of each tone monitor is continuously scanned by the system on the associated pair of leads (scan points) which is brought out to the signal processor. The normal condition for each pair of leads is that a closure will exist when the levels of the tone voltages are within specified limits. If any tone voltage level drops by at least 3 dB below the normal level, the monitor will detect this and provide an open circuit between its output scan terminals, which is detected by the system.

3.07 The capability is provided to test each monitor by simulating a 3 dB drop in voltage to the monitor. This is done by system operation (via signal distributor points) of a test relay associated with each side of the 820A plant. A red light-emitting diode is provided on the faceplate of each tone monitor circuit pack. The normal state of the lamp is off (when voltage levels are within specifications).

B. J87337A Inverter Monitoring

3.08 The output of each of the two J87337A inverters is continuously monitored by a no-voltage alarm circuit. An additional monitor is provided on the bus to detect the absence of voltage on the bus. These monitors consist of a relay powered by the output of each inverter. Should an inverter fail, its associated relay releases. The releasing of this relay provides a closure of scan points which notifies the signal processor of an inverter failure.

C. Interrupter Circuit Monitoring

3.09 The interrupter monitoring circuits for each side of the plant are comprised of three circuit packs which are used to monitor the 10 ipm, 60 ipm, and 120 ipm interrupted signals. Failure of any of the three interrupted signals is detected by the associated interrupter monitor circuitry

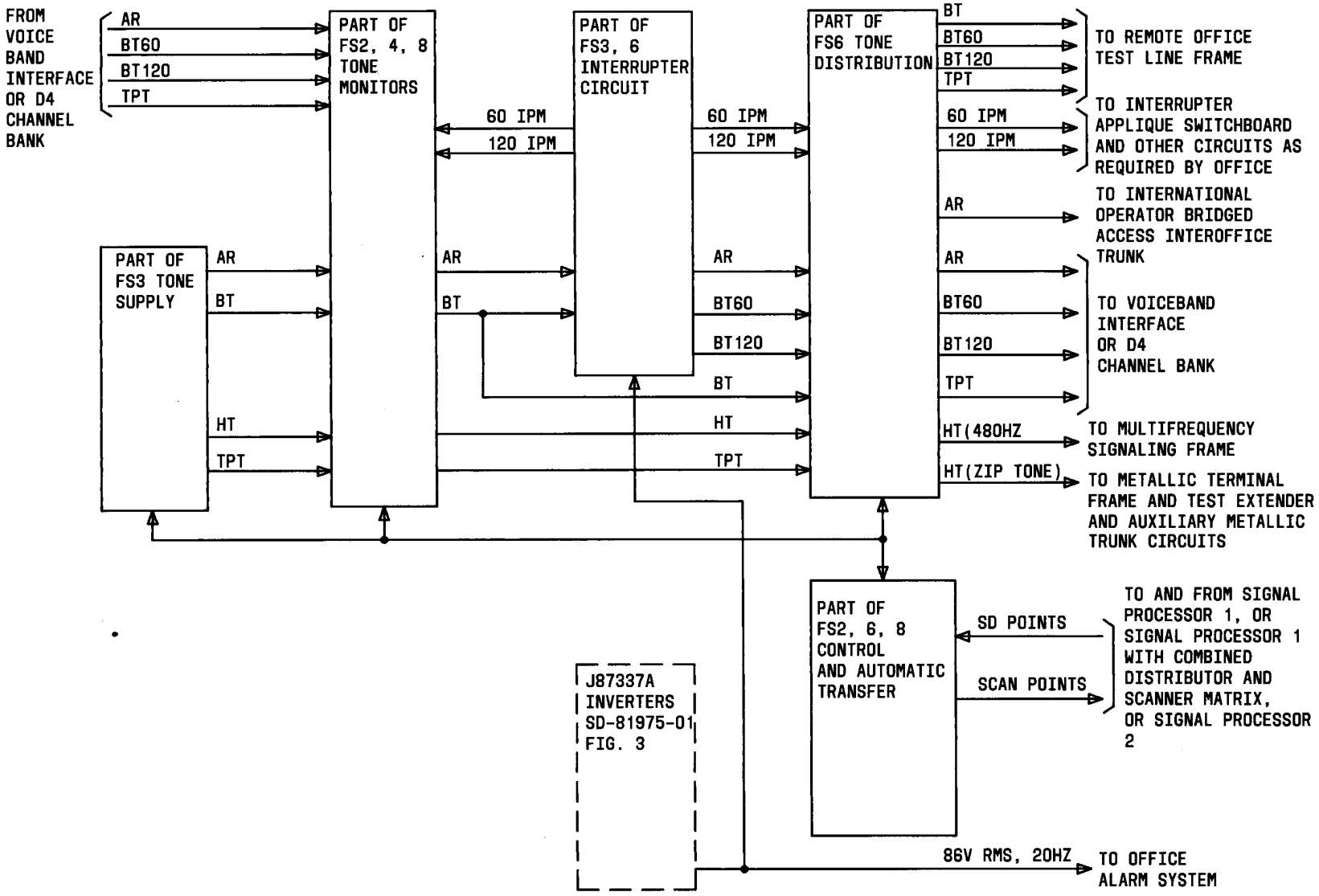

Fig. 2—820A Ringing, Tone, and Interrupter Plant—Functional Block Diagram

which provides closure of a scan point to notify the signal processor of an interrupter failure.

J87337A INVERTERS

3.10 The J87337A inverters are used by the 820A plant to provide an 86-volt, 20-Hz signal to the office alarm system and an internal timing signal (Fig. 3).

Each inverter consists of the following functional circuits:

- DC input line filter
- 20-Hz oscillator inverter
- Ferroresonant regulator
- Output filter.

3.11 The dc input line filter reduces the noise fed back to the battery from the inverter and the source impedance presented to the inverter by the battery. The 20-Hz oscillator of the inverter determines the frequency of the circuit and converts the dc voltage at the filter output to an ac square-wave voltage at the ferroresonant regulator input.

3.12 The filtered ferroresonant regulator converts the unregulated ac square-wave voltage from the oscillator stage into a sinusoidal voltage, regulated for input voltage and load current variations. The output filter works in conjunction with the ferroresonant regulator to provide a further improvement in the waveshape of the inverter output voltage.

INTERRUPTER CIRCUIT

3.13 Duplicate interrupter timing circuits are provided in the 820A. The INT-0(1) circuit pack (CPA 1006) provides the basic 10 ipm, 60 ipm, and 120 ipm interruption rates. A 20-Hz square-wave signal from the J87337A inverters is applied to this pack as a timing signal. The interrupted outputs from CPA 1006 drive mercury relays in the INT REL-01(11) circuit pack (CPA 1005). Continuous audible ring and busy tones are connected to the contacts of these relays which are wired in various combinations to produce the interrupted tones required by the system.

TONE DISTRIBUTION

3.14 Distribution of continuous and interrupted tones is a function of this circuit. Balanced distribution is accomplished by tone distribution splitting-resistors. These resistors are multiplied at the plant output in accordance with the basic number required by the individual ESS office. Transfer of the tone outputs from the "0" side to the "1" side takes place ahead of the distribution resistors, which are not duplicated for each side.

CONTROL AND TRANSFER CIRCUIT

3.15 Control and transfer of the 820A plant can be classified in the following three areas:

- Manual
- Autonomous
- System.

A. Manual

3.16 Manual transfer control of the 820A plant is accomplished by operation of the OFF-0 or OFF-1 switch. The OFF-0 and OFF-1 switches transfer the plant load and remove power from their respective sides. Further explanation of these switches is contained in Part 4. Manual override to system control is provided mainly for maintenance purposes.

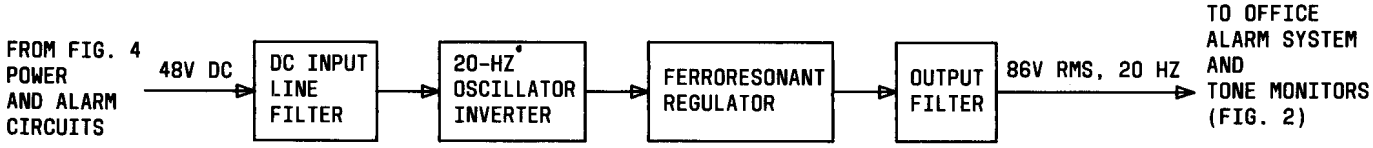

Fig. 3—J87337A Inverter—Functional Block Diagram (SD-81975-01)

3.17 Manual transfer to the J87337A inverters can be initiated by operation of the INV TRFR or INV RESET switches. Operation of the INV TRFR switch will transfer the inverter loads from the "0" to the "1" side. Operation of the INV RESET switch transfers the loads from the "1" to the "0" side. The two INV switches control the operation of the TR relay. The output of each inverter is supplied to contacts of the TR relay in an either-or arrangement.

B. Autonomous

3.18 An important feature in this plant is that the transfer of loads from INV 0 to INV 1 is independent of system control. In the event of a failure in the output of INV 0, the plant will automatically transfer the load to INV 1. This autonomous feature of the inverters is provided to ensure that 86 volts, 20 Hz, will be available for alarm and timing purposes if the system-controlled transfer arrangements should malfunction.

C. System

3.19 Tone and interrupter load transfer in the 820A is controlled by the signal processor. Troubles are detected by the signal processor by means of scan points. Commands to transfer or test from the signal processor to the 820A are in the form of SD points. See Part 2 for a discussion of scan and SD points.

3.20 When the signal processor initiates a command to transfer 820A loads, it places a closure or open on the SD points which control the T relay. If a closure is applied, the transfer will be from the "0" side to the "1" side. An open will transfer loads from the "1" side to the "0" side.

4. THEORY—POWER AND ALARM CIRCUITS

INTRODUCTION

4.01 The coverage in this part includes:

- Discussion of power input to frame
- Power distribution within the 820A
- Power control
- Discussion of alarm circuits.

4.02 Distribution of the power through the ringing, tone, and interrupter frame and the alarm circuit is shown in Fig. 4. This diagram shows the basic input and distribution of power to different units within the 820A.

POWER INPUT TO THE 820A PLANT

4.03 The 820A receives its input power from the power distribution system. Power requirement for the 820A is -48 volts dc at 4.5 amperes under full load conditions. Power is furnished via A and B buses from the power distribution frame to the plant through P01 and P11 power contactor relays. The A bus supplies power to the "0" side of the plant while the B bus supplies power to the "1" side.

POWER DISTRIBUTION WITHIN THE 820A

4.04 Frame filters in the 820A are provided for the two -48 volt dc inputs to the plant. The filter units suppress any noise from the power distribution system to the 820A and also isolate any 820A noise from the power distribution system. The -48 volts dc are then sent to the -48 volt fuses.

4.05 The -48 volt fuses are grouped in three major areas: "0" side, "1" side, and control fuses. The "0" and "1" side fuses are arranged to protect the duplicate circuitry in the 820A. The control fuses protect the transfer circuitry and the other circuitry which must remain powered when power is removed from either the "0" side or the "1" side.

POWER CONTROL

4.06 Manual power control is accomplished by the OFF-0, OFF-1, and NOR pushbutton switches. The switches are mechanically interlocked so that only one can be depressed at a time. This ensures that power cannot be removed from both sides of the plant at one time.

4.07 If the plant is operating under normal conditions (NOR switch depressed) and it is desired to remove power from either side, the only step necessary is to depress the OFF-0 or OFF-1 switch. An exception to this rule is made when the INV TRFR lamp is lighted and it is desired to remove power from the "1" side or when the plant is operating with the "0" side off.

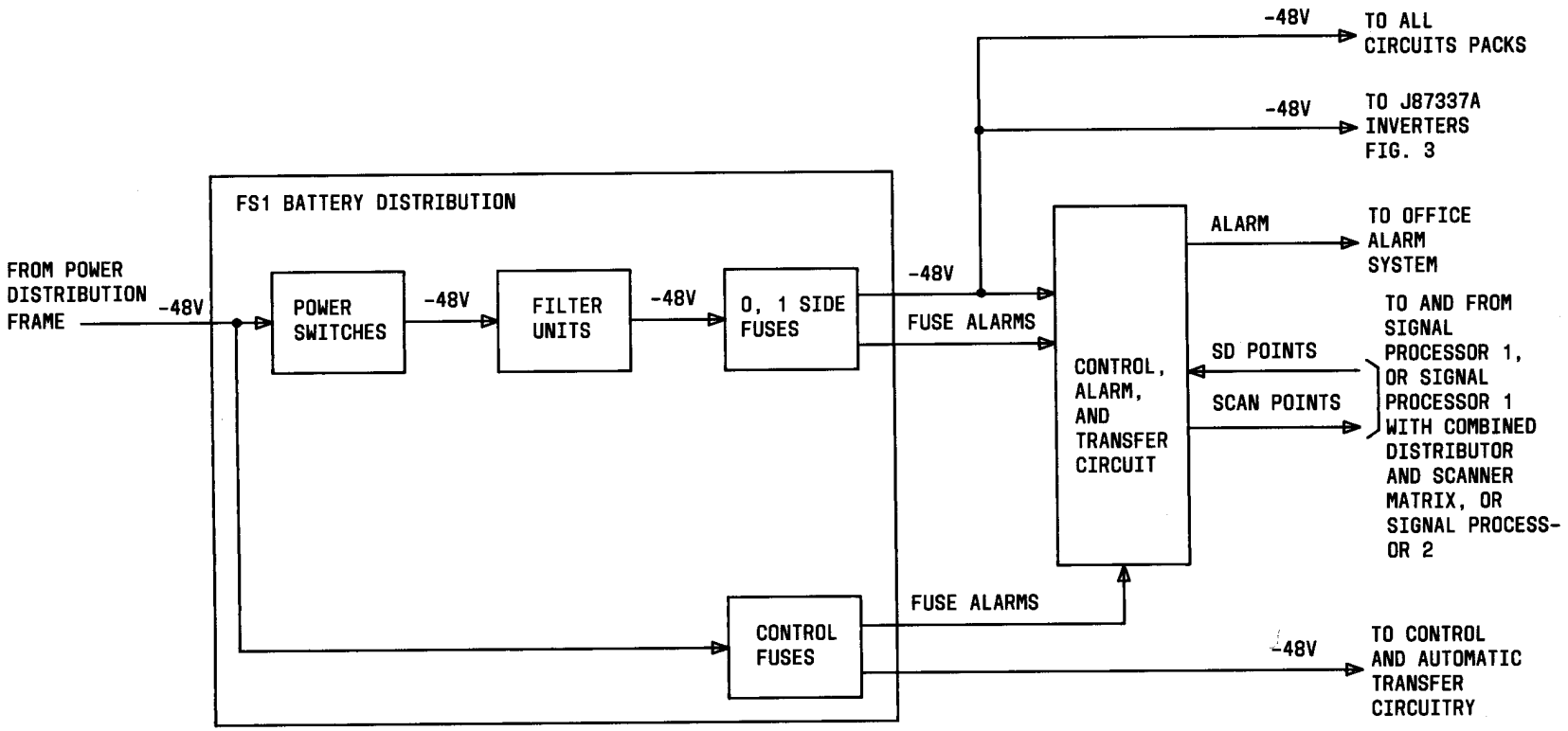

Fig. 4—820A Ringing, Tone, and Interrupter Plant—Power and Alarm Circuits (SD-82157-01)

When these two conditions exist, it is necessary to depress both the INV RESET and the OFF-1 switches. The order in which these switches are depressed is not important. If the plant is operating with either the OFF-0 or OFF-1 switch depressed and it is desired to restore power to both sides of the plant, the NOR switch must be depressed. The system will then automatically scan the operational status to determine whether the inverter loads should be transferred back to the "0" side.

ALARM CIRCUITS

4.08 The 820A transmits a closure directly to the office alarm grid whenever a fuse alarm condition exists. Fuse alarms are generated whenever any one of the 70-type fuses in the plant operates. The 70-type fuses provide a battery signal to the fuse alarm relays (FA0 or FA1) when operated. The fuse alarm relays in turn provide the closure to the office alarm system. The alarm can only be generated when the plant is operating in the normal operating state (NOR switch depressed). Operation of the OFF-0 or OFF-1 switch will extinguish the alarm.

5. REFERENCES

5.01 The following listing provides further information concerning the 820A plant:

NUMBER	TITLE
234-100-000	No. 4 Electronic Switching System, Description
234-100-021	No. 4 ESS Input/Output System, Description, and Theory
234-100-040	No. 4 ESS Office Alarm System, Description, and Theory
234-100-060	No. 4 ESS Power Distribution System, Description, and Theory
234-010-002	No. 4 ESS Abbreviations and Acronyms
167-728-100	820A Ringing, Tone, and Interrupter Plant, Description
SD-82157-01	820A Ringing, Tone, and Interrupter Plant
SD-81975-01	Inverter Circuit-J87337A 20-Hz, 86 Volts
SD-82156-01	Ringing, Tone, and Signaling Circuits General Use Circuit Packs
SD-81885-01	Signaling Circuit Pack Schematics