

TYPE N2 CARRIER SYSTEM
ALARM AND RESTORAL UNIT
FOR PACKAGED N2 TERMINALS

DESCRIPTION

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1. GENERAL

1.01 This section describes the physical and functional characteristics of the alarm and restoral unit used in packaged N2 terminals. The alarm and restoral unit detects and indicates failure of incoming carrier signals or excessive deviations in the -21 volt supply voltage. When a carrier failure is detected, the circuits in the alarm and restoral unit cause a carrier group alarm unit to remove the affected trunks from service. When the failure is cleared, the alarm and restoral unit automatically returns the trunks to service.

1.02 Under normal conditions the incoming carrier signals prevent the carrier alarm circuits from registering an alarm condition. When the carrier signals are interrupted for more than 1.5 to 2 seconds, circuits in the alarm and restoral unit activate visible and audible

office alarms and apply a "system alarm signal" to the carrier group alarm unit. A second alarm signal is applied to the carrier group alarm unit approximately 15 seconds later. These alarm signals cause the carrier group alarm unit to process associated trunk circuits to stop service charges, release established connections, and make trunks busy. The alarm and restoral unit causes the terminal to both transmit and receive 2600-cycle tones on two test channels as a means of determining when the trouble is cleared. When proper test signals are transmitted and received at both terminals, the alarm and restoral circuit automatically restores the system to normal.

1.03 The alarm and restoral unit also registers an alarm condition if the -21 volt supply voltage deviates in excess of ± 1 volt. This alarm condition registers audible office and visible bay alarms, but does not activate the carrier group alarm unit.

2. EQUIPMENT DESCRIPTION

2.01 The alarm and restoral unit (see Fig. 1) consists of two subassemblies. One subassembly contains the power supply alarm circuit and part of the carrier alarm circuit; the other subassembly contains the carrier alarm, test, and restoral circuit. Components for each circuit are attached to circuit boards which are mounted on standard N2 castings. The castings are connected together by four brackets. The over-all unit, which is approximately 5 inches high and 3-1/4 inches wide, plugs into the center shelf of a packaged N2 terminal between the power supply and the line terminating unit. Each subassembly has a 20-pin connector on the back, which mates with a jack in the terminal mounting.

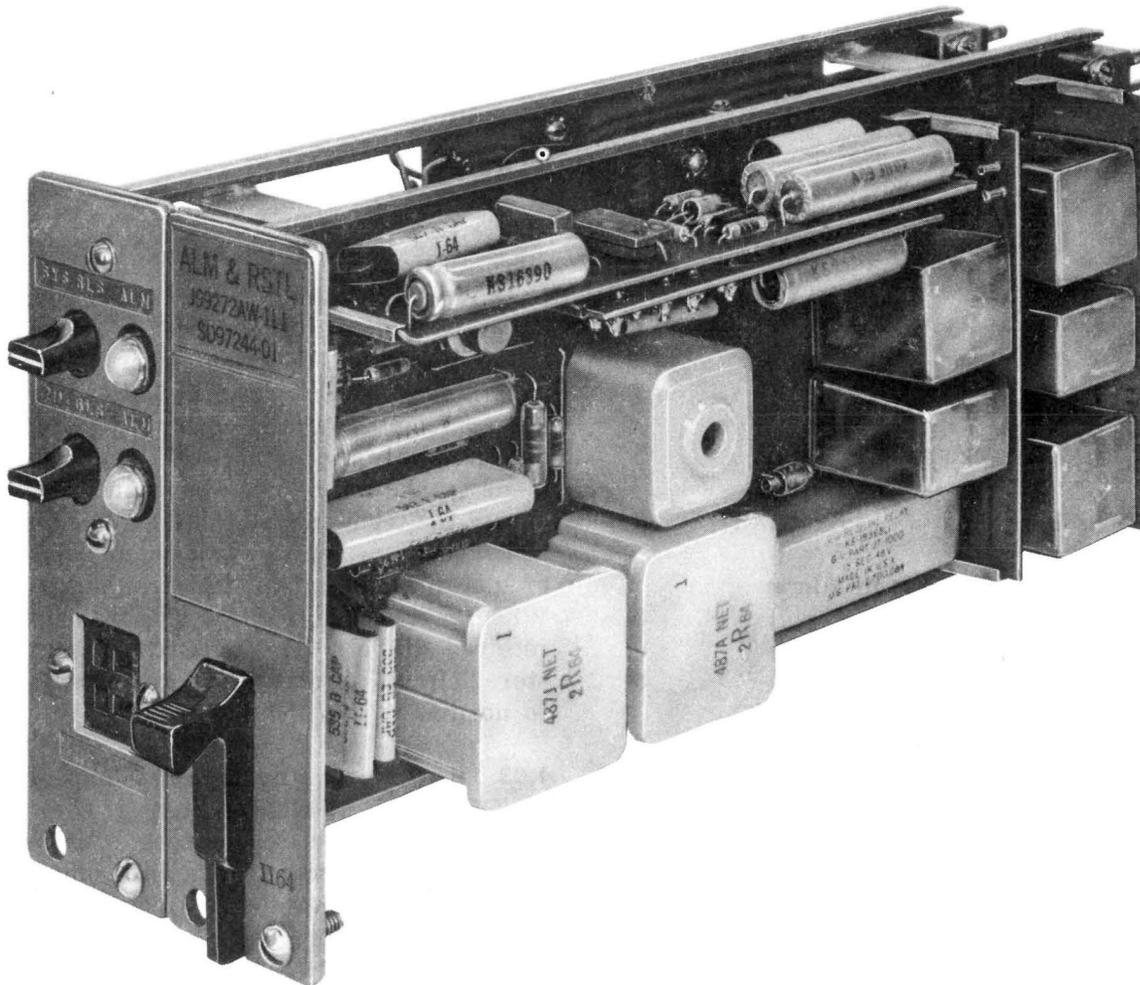


Fig. 1 — Alarm and Restoral Unit

2.02 The front panel of the alarm and restoral unit provides two alarm lamps, two keys, and a test jack. The alarm lamps provide a visible indication when either the -21 volt supply has failed or a carrier failure is detected. The keys, when operated, silence the office alarms for either a -21 volt supply failure or carrier failure. The test jack provides connections for an N2 switching set, which is used to switch the terminal from the normal -21 volt supply to an alternate -21 volt supply without disrupting service. This jack can also be used to check the operation of the -21 volt power supply alarm circuit.

3. FUNCTIONAL DESCRIPTION

A. General

3.01 The N2 packaged terminal alarm and restoral unit consists functionally of two separate circuits: the -21 volt power supply alarm circuit, and the carrier alarm circuit. The -21 volt power supply alarm circuit detects deviations which exceed ± 1 volt. When the limit is exceeded, the circuit registers visible and audible alarms. The carrier alarm circuit detects failure of received carrier signals. When a carrier failure is detected, this circuit activates

alarm lamps, alarms the distant terminal, conditions an associated carrier group alarm circuit to remove the terminal from service, sets up tests for determining when normal transmission is restored, and, when the fault is cleared, signals the carrier group alarm circuit to restore service.

B. -21 Volt Power Supply Alarm Circuit

3.02 A simplified drawing of the -21 volt power supply alarm circuit is shown in Fig. 2. A detailed drawing is shown in Fig. 3. The -21 volt power supply alarm circuit consists of a phase inverter stage and a Schmitt trigger stage. Transistor Q1, resistors R1, R4, R6, and R7, potentiometers R2 and R5, and diodes CR2 and CR3 form the inverter stage; transistors Q2 and Q3, together with resistors R8 and R10 through R14, form the Schmitt trigger stage.

3.03 The purpose of the phase inverter stage is to increase the negative voltage at the base of transistor Q2 whenever the power supply deviates ± 1 volt from its nominal -21 volt value. This drives transistor Q3 into saturation.

The purpose of the Schmitt trigger stage is to initiate office alarms by releasing normally-operated relay P whenever there is a power supply deviation.

3.04 Power Supply Failure: Voltage from the -21 volt power supply is applied to the base of transistor Q1 through diode CR1 and varistors RV1 through RV4. When the power supply voltage is within limits, diodes CR2 and CR3 are both conducting; transistor Q2 is biased to cutoff; transistor Q3 is biased to saturation; and relay P is operated.

3.05 When the power supply voltage increases (becomes more negative than -22 volts), transistor Q1 becomes more negatively biased, thus reducing its collector voltage to the point that CR2 becomes back-biased and nonconducting. Diode CR3, however, conducts more heavily because the voltage at the junction of potentiometer R2 and diode CR3 has become more negative. Current through R7 increases, causing the voltage at the base of transistor Q2 to become more negative. This condition causes transistor Q2 to be biased into saturation. With Q2

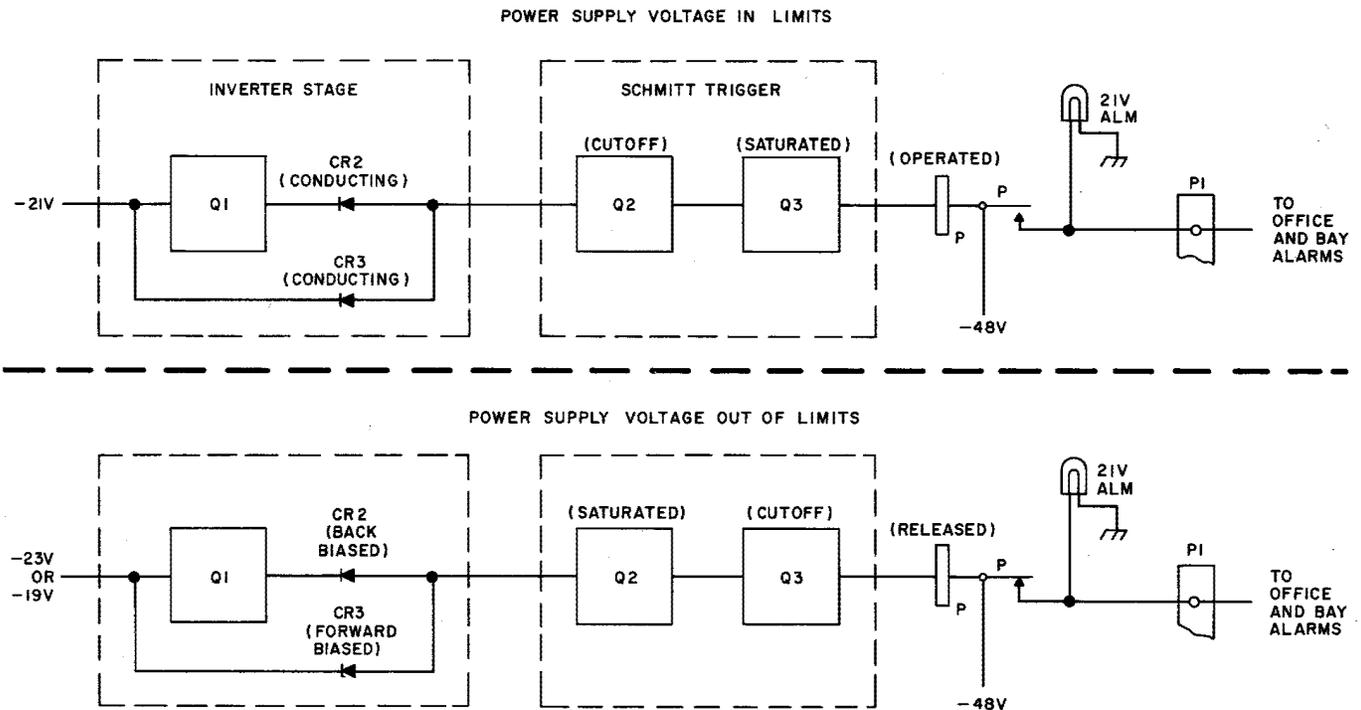


Fig. 2 — -21 Volt Power Supply Alarm Circuit, Simplified Block Diagram

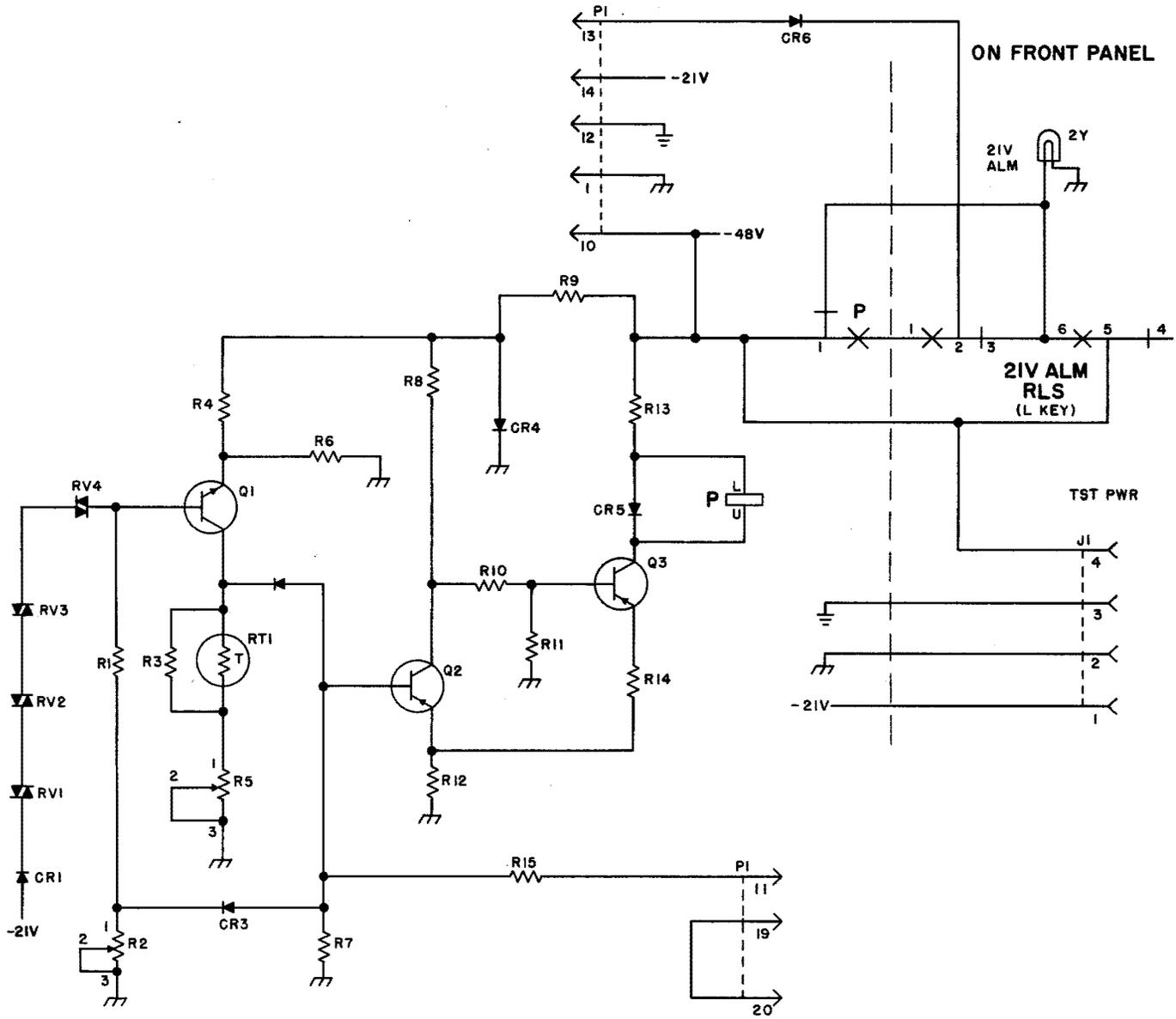


Fig. 3 — -21 Volt Power Supply Alarm Circuit

driven into saturation, current flows through resistor R12. This causes a voltage drop across R12, which makes the emitter of transistor Q3 more negative than the base, and the transistor is cut off. This releases relay P and consequently operates the office alarms, lighting the 21V ALM lamp.

3.06 When the power supply voltage decreases below -20 volts, the base of transistor Q1 becomes more positively biased, thus increasing the collector voltage and causing diode CR2 to conduct more heavily. Diode CR3, however, is for all practical purposes cut off, since the voltage at the junction of resistor R2 and diode CR3 becomes more positive. This condition causes transistor Q2 to be biased into saturation and transistor Q3 to be biased into cutoff, thus releasing relay P and initiating office alarms.

3.07 Operation of Office Alarms: The office alarms are initiated when -48 volts is applied to terminal 13 of plug P1. Application of this voltage is controlled by relay P. Under normal conditions relay P is operated and the -48 volt path to P1 is open. When the power supply has a deviation greater than ± 1 volt, relay P releases, enabling -48 volts to be applied through the 21V ALM RLS key and diode CR6 to plug P1. The 21V ALM lamp will light when relay P releases. The -48 volts at plug P1 operates a relay in the power alarm and miscellaneous circuit panel which, in turn, operates an alarm lamp and activates an audible office alarm.

3.08 Release of Office Alarms: After an alarm condition has occurred, the office alarms can be silenced and the bay lamp extinguished by manually operating the 21V ALM RLS key, which removes the -48 volts from plug P1. The 21V ALM lamp, however, remains lighted as a reminder that the power supply associated with the failure is not within its ± 1 volt tolerance. When the power supply is restored to normal, -48 volts will again be applied to plug P1 through the key and diode CR6. This starts the alarm sequence again. To release the office alarms and to extinguish the alarm lamps, the 21V ALM RLS key must be returned to its normal position.

3.09 The office alarms associated with the failure of the -21 volt power supply are termed "minor alarms" because the terminal

can still function even though the power supply voltage is out of limits.

C. Carrier Alarm Circuit

General Description of Operation

3.10 This circuit, shown in simplified form in Fig. 4 and in detail in Fig. 5 and 6, is used as a carrier failure detector, a monitoring circuit, and a means of initiating the restoral process. During normal operations, when carrier is being received, transistors Q4 and Q5 form a 2-stage amplifier, which amplifies the received signal. A half-wave voltage doubler rectifier circuit, consisting of capacitors C10 and C11 and diodes CR10 and CR11, rectifies the signal from the amplifier. The rectified positive dc signal biases transistor Q7 to cutoff, thus ensuring that relay CS (which initiates the alarm process) is nonoperated. When the received carrier fails, the loss of positive dc biasing voltage causes transistor Q7 to saturate, thus enabling relay CS to operate. Operation of relay CS for a minimum of 1.5 seconds initiates the alarm process.

3.11 Carrier Failure: Under normal, non-alarmed conditions relays in the alarm and restoral circuit (see Fig. 6) are released and the guard circuit is disconnected from the signal path by relay contacts. When the received carrier fails, the positive output of the voltage doubler (CR10 and CR11) is too small to keep transistor Q7 biased to cutoff. Thus, the transistor is turned on and relay CS operates.

3.12 When relay CS operates, a trouble indication is applied to an ESS office by removing battery from lead 31. In addition, ground is applied to relay SA through thermistor RT2. This thermistor provides a 1.5- to 2.0-second delay to prevent registering alarms for hits or momentary faults.

3.13 When relay SA operates, it locks on a ground present on lead 30 from the carrier group alarm circuit. Operation of this relay allows cooling of thermistor RT2 and simultaneously causes the operation of the following:

- (a) Lamp SYS ALM.
- (b) Relay MJN in the power alarm and miscellaneous circuit. Relay MJN lights a frame alarm lamp and activates visible and audible office alarms.

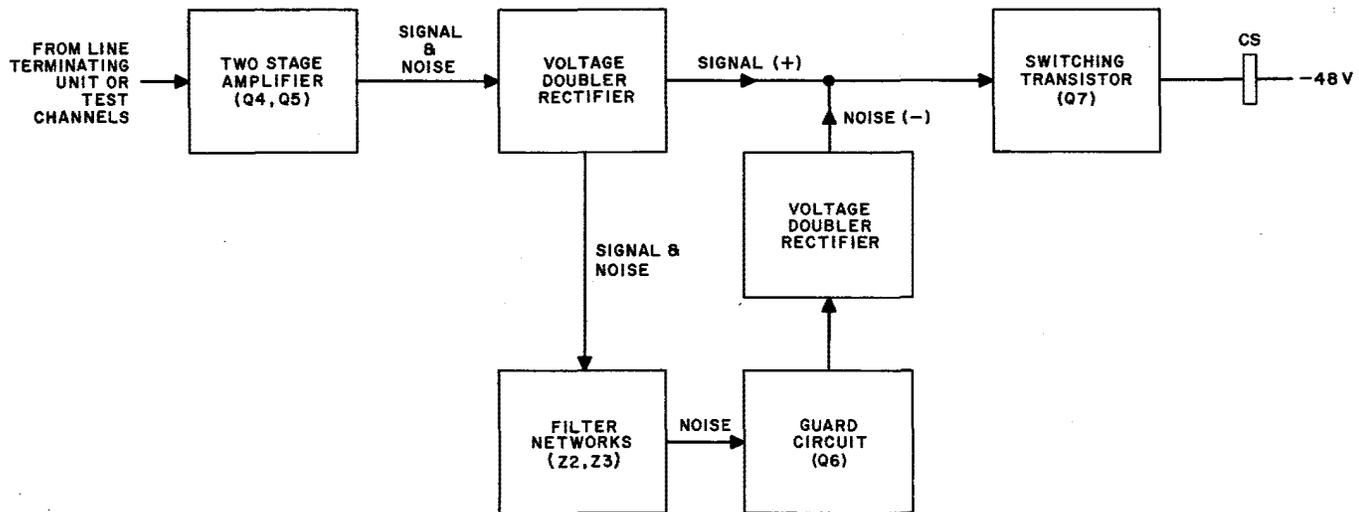


Fig. 4 — Carrier Failure Alarm, Test, and Restoral Circuit, Simplified Block Diagram

(c) Relays RR1 and RR2 mounted on the back of the terminal shelf. When operated, these relays open the path between the compandors and modems in channel positions A and B (test channels 1 and 2) and apply a 2600-cycle tone at the modulator input of the modem in channel position A. These relays also connect the demodulator outputs of the channels in channel positions A and B to the alarm and restoral circuit.

(d) Thermal relay T.

(e) Relay K3 in the line terminating unit. Relay K3, when operated, removes -21 volts from the group transmitting unit, thus alarming the distant terminal. Relay K3 also applies a ground over lead SA to provide the system alarm signal to the carrier group alarm circuit.

3.14 Thermal relay T provides the second delay in the alarm and restoral circuit. This relay will operate approximately 15 seconds after relay SA operates. Operation of relay T furnishes an operating path for relays DS and DS1. Operation of relay DS1 restores the -21 volt supply to the group transmitter, which reapplies outgoing carrier. Operation of relay DS removes shunting resistor R50 and optional re-

sistors R29 and R30 from the amplifier feedback path. (See Fig. 5.) This increases amplifier gain for monitoring purposes. The DS relay, when operated, also removes shorts from resistors R34 and R39 and adds the guard circuit for monitoring purposes. Removing the short across resistor R34 reduces 2600-cycle tone sensitivity and improves impedance at the input of the guard circuit. Removing the short across resistor R39 allows the guard circuit output voltage to be combined with the signal voltage at the base of transistor Q7 and permits the sum of the signal and guard voltage paths to determine the on or off condition of transistor Q7. Operation of relay DS1 grounds leads DS and E2 to the carrier group alarm unit. Ground on lead DS provides the "delayed alarm signal" to the carrier group alarm circuit. Ground on lead E2 holds the carrier group alarm operated when ground is removed from lead SA after completion of the first phase of the restoral process. Relay M1 is operated when a make contact of DS1 closes to a ground placed on lead 31 by the carrier group alarm circuit. Operation of relay M1 closes the path between the demodulator output of the modem unit in channel position A and the monitor circuit. It also disconnects 2600-cycle tone from the modulator input of the modem unit in channel position B. A sequence diagram of alarm operation is shown in Fig. 7.

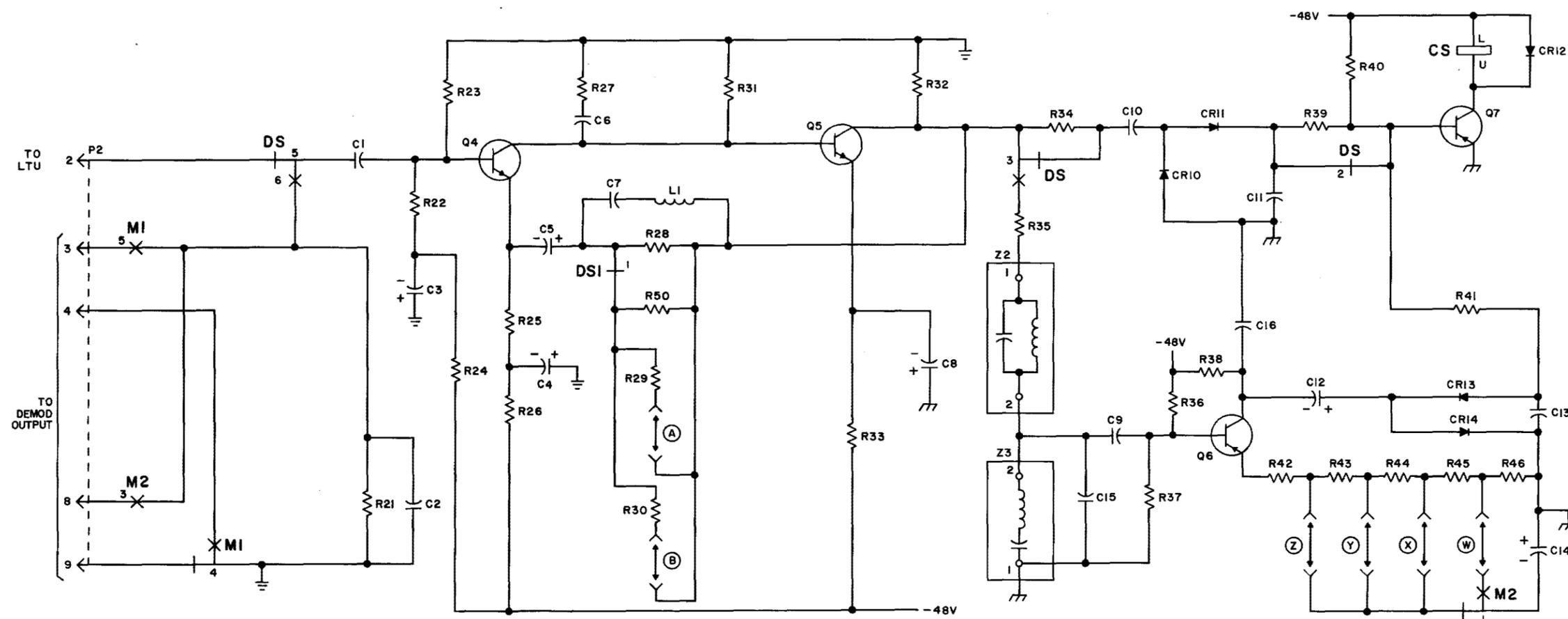


Fig. 5 — Carrier Failure Alarm, Test, and Restoral Circuit

ALARM AND RESTORAL CKT

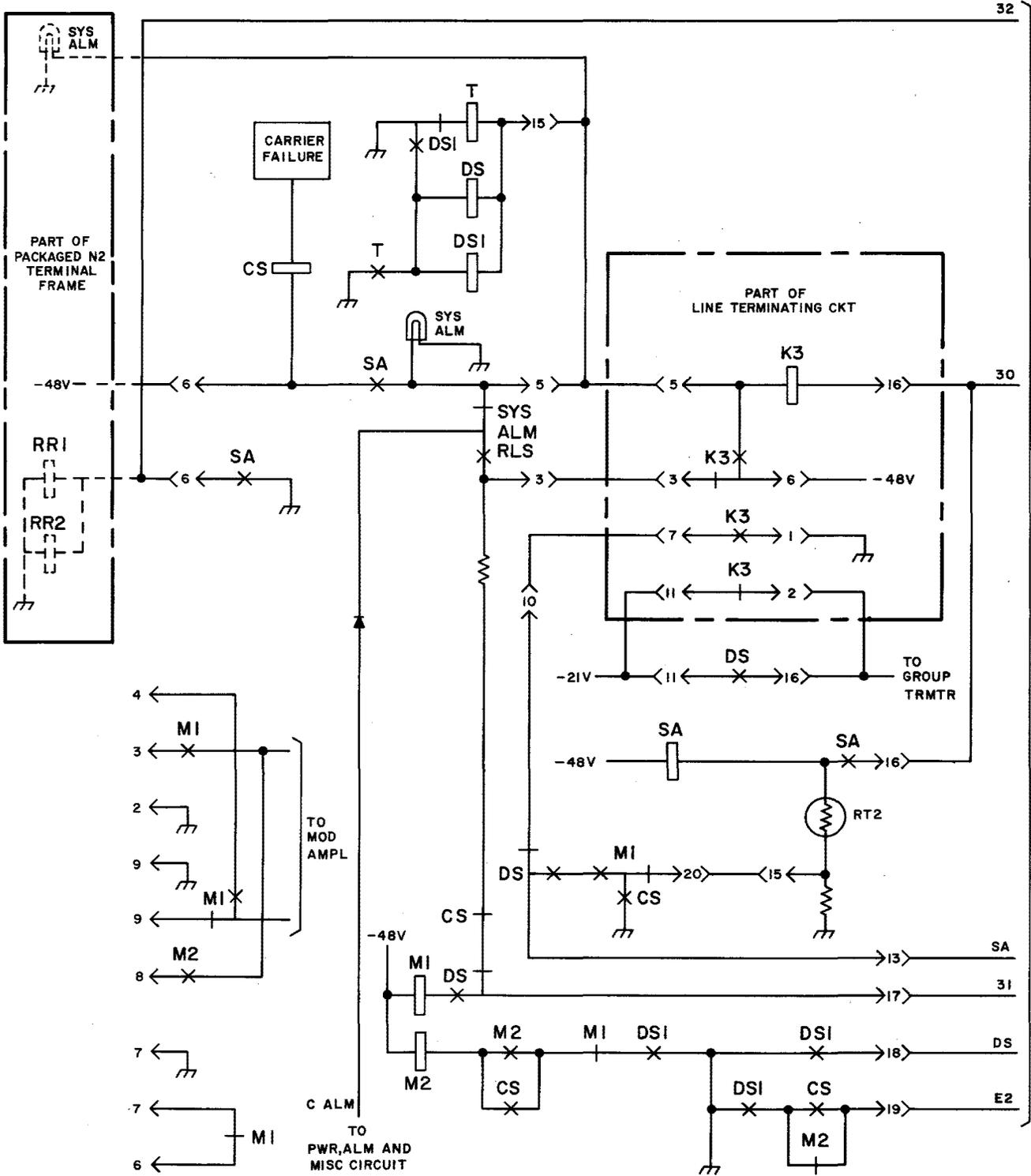


Fig. 6 — Alarm and Restoral Unit, Relay Circuit

3.15 Release of Office Alarms: After a carrier alarm has been initiated, the office alarms can be silenced and the bay alarm lamp extinguished by manual operation of the SYS ALM RLS key. Operating this key removes -48 volts from relay MJN in the power alarm and miscellaneous circuit. The SYS ALM lamp in the unit, however, remains lighted. When the fault on the carrier system is cleared, the SYS ALM lamp is extinguished and -48 volts is again applied to relay MJN, which activates office alarms and the bay alarm lamp. When the SYS ALM RLS key is returned to normal, the SYS ALM lamp and the bay alarm lamp will be extinguished and the office alarms silenced.

System Restoral

3.16 At the nonfailed end of the system, a 2600-cycle tone is present at the output of the demodulator of test channel 1 (channel position A) almost immediately after the monitor circuit is connected. There should be very little noise present at this time since the line repeaters have not had time to regulate to high gain. The 2600-cycle tone is amplified and the amplifier output is rectified in the voltage doubler. This positive dc voltage is then delivered to the base of transistor Q7, biasing the transistor to cutoff. Relay CS is then released. Release of relay CS removes ground on lead SA, thus starting the time-out process in the carrier group alarm circuit. After approximately 10 seconds, the carrier group alarm circuit removes ground from lead 31, which allows relay M1 to release. Release of relay M1 provides an operate path for relay M2. The release of relay M1 and the operation of relay M2 switch the monitor circuit input to the demodulator output of the modem in channel position B. The release of relay M1 also reconnects 2600-cycle tone to the modulator input of the modem in channel position B. Since there is no 2600-cycle tone on the second channel at this time, relay CS again operates.

3.17 At the failed end of the system none of the events discussed in 3.16 can occur until the fault is cleared. Immediately after the fault is cleared, a signal consisting of 2600-cycle tone plus noise is present at the demodulator output of test channel 1. The signal is amplified and

then divided by networks Z2 and Z3 into 2600-cycle tone and noise components. (The intensity of the noise components is dependent upon the length of time the system was out of order, and the number of repeater sections between the terminal and the point where the fault had occurred.) The 2600-cycle tone is rectified by the voltage doubler (comprised of CR10 and CR11) and the positive dc voltage is applied to the base of transistor Q7. The noise component of the signal is applied to the base of transistor Q6, the amplified signal is rectified by the voltage doubler (comprised of diodes CR13 and CR14), and the negative dc voltage is applied to the base of transistor Q7. The positive and negative dc voltages applied to the base of transistor Q7 are proportional to the amplitudes of the 2600-cycle tone and noise signals, respectively. The positive dc voltage at the base is at a fixed voltage but the amount of negative dc voltage depends upon the level of noise received on the test channel. A negative voltage above a certain level at the base of transistor Q7 keeps the transistor saturated. The noise level must fall to a value where the signal-to-noise ratio approaches the normal requirements of a message channel for that particular system. The signal-to-noise ratio of the circuit can be adjusted for systems with normally high- or low-level noise by adjusting the feedback in the guard amplifier. This is accomplished by use of the X, Y, or Z options. Option Z provides the highest signal-to-guard ratio and option X the lowest. Option Y has a signal-to-guard ratio approximately midway between Z and X. When the noise falls to a point where the signal-to-guard ratio is of the proper magnitude, the negative voltage at the base of transistor Q7 is reduced so that the transistor is cut off and relay CS releases. Circuit action after release of relay CS was explained in 3.16.

3.18 After the fault has been repaired, the repeater begins to regulate on the carrier signal. Initially the noise and crosstalk go from high to low values sporadically. This causes relay CS to operate and release with the rise and fall of the noise level and in turn will start and stop the time-out process in the delay circuit of the carrier group alarm unit. This action delays the restoral process until the line becomes stabilized.

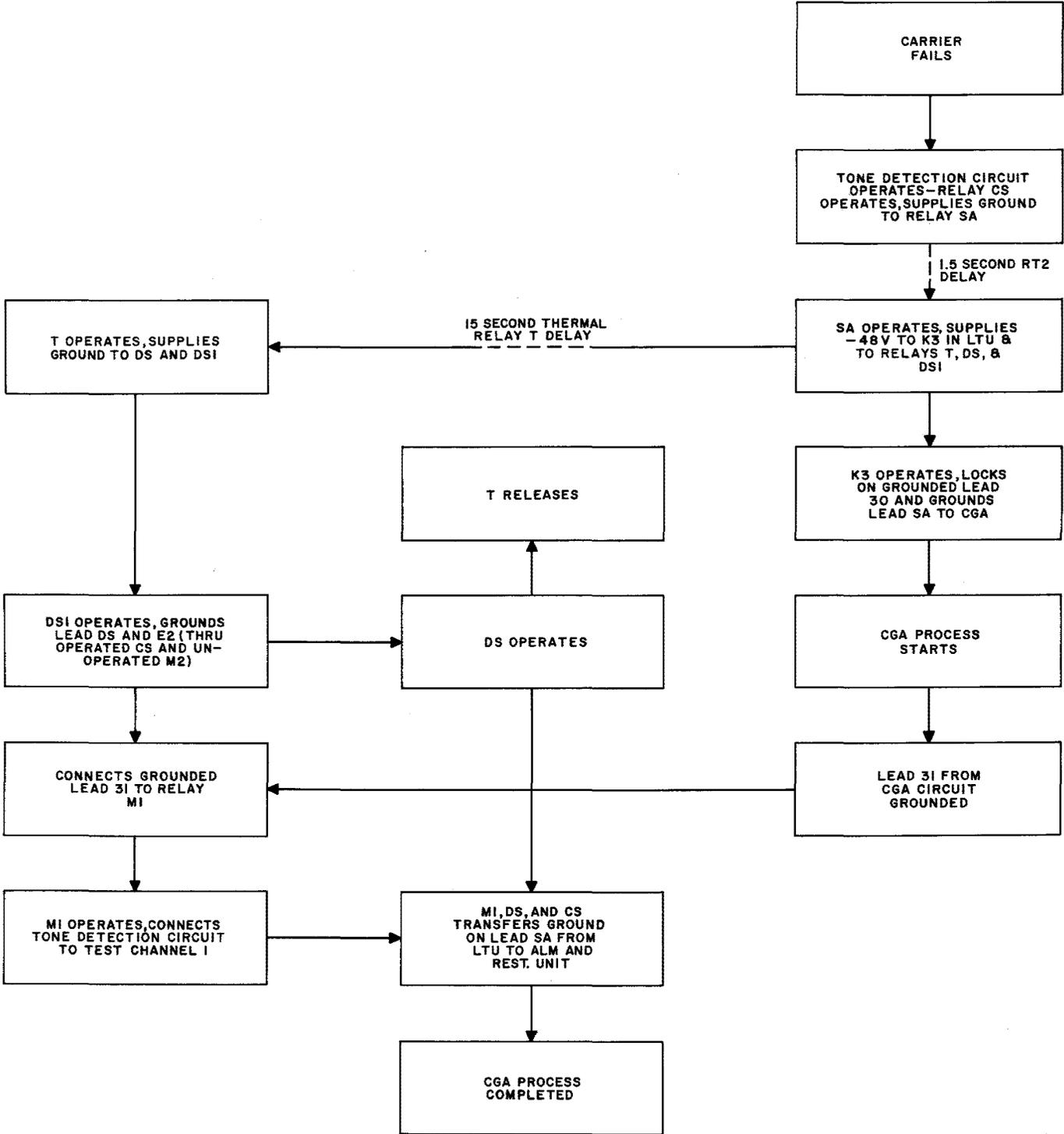


Fig. 7 — Alarm and Restoral Unit, Alarm Sequence

3.19 The restoration to service is coordinated at both terminals, since at the failed terminal receipt and transmission of 2600-cycle tone over the second test channel occur almost simultaneously. At both terminals 2600-cycle tone which is received over the second test channel is amplified and rectified in the alarm and restoral circuit, causing the release of relay CS. With relay M2 still operated and relay CS released, ground is removed from lead E2, which causes the carrier group alarm circuit to remove ground momentarily from lead 30. This allows relay SA to release, which in turn releases relays DS and DS1. Release of DS1 releases relay M2. The alarm circuit is now completely restored to normal.

3.20 To ensure that the 2600-cycle tone received on the second test channel at the nonfailed end is of long enough duration to complete the restoral at the terminal, bay relays RR1 and RR2 are held operated by the carrier group alarm circuit until it is completely restored. This provides a 2600-cycle tone at the nonfailed end for more than 200 milliseconds, which is more than adequate for assurance of complete restoral of the system.

D. Removal of Alarm and Restoral Unit From Terminal

3.21 The alarm unit can be removed from its position in a working terminal without disrupting service. When this is done, an alarm loop is opened and an alarm indication appears in the office. If an alarm condition occurs while the unit is removed from the terminal, no trunk processing will occur and no indication of the trouble will be registered. If the unit is removed while an alarm condition is registered, the associated carrier group alarm circuit will be released and the simulated busy condition will be removed prematurely from the trunk circuits.

4. DRAWINGS

4.01 The following schematic and equipment drawings (not attached) provide detailed information.

SD-97244-01 — Alarm and Restoral Circuit

SD-97256-01 — Application Schematic for Packaged N2 Terminals

SD-97259-01 — Carrier Group Alarm and E-type Signaling Connecting Circuit