

## MINI-REG SYSTEM AND 7A RANGE EXTENDER WITH GAIN DESCRIPTION AND OPERATION

	PAGE		PAGE
1. GENERAL . . . . .	1	5. Mini-REG Power Fuse and Alarm Panel . . . . .	9
2. DESCRIPTION . . . . .	2		
A. Mini-REG Bays, Frames, and Shelves . . . . .	2	1. GENERAL	
B. 7A REG Plug-In . . . . .	2	1.01 This section describes the 7A REG (Range Extender With Gain) and the Mini-REG System. The Mini-REG System is a newer, more compact, per-line REG designed to supersede the older 5A REG System. The Mini-REG System consists of a new VF (voice frequency) range extension plug-in, the 7A REG, and a new bay arrangement, the Mini-REG bay (J98631A).	
3. FUNCTIONS . . . . .	5	1.02 This section is reissued to rate the connectorized backplane (ED-97931-30, GR1) Mfr Disc. The associated frames and equipment for this backplane are rated Mfr Disc. They are J98631A, Lists 1 through 11.	
A. Mini-REG System . . . . .	5	1.03 The 7A REG is also used as the key element in the CREG (Concentrated Range Extender With Gain) System. This practice describes the 7A REG for both applications.	
B. 7A REG as Mini-REG . . . . .	6	1.04 The 7A REG is a VF REG that provides both signaling and transmission extension for POTS (plain ordinary telephone service) out to 2800 ohms conductor loop resistance. This design incorporates the desirable features of past REGs and adds these new features:	
C. 7A REG for CREG Applications . . . . .	6	• Significant size reduction which makes it possible to accommodate four times as many channels per bay.	
4. OPERATION . . . . .	6	• Universal application wherein the 7A plug-in can be used for both per-line applications under long route design in all offices and for	
A. 7A REG . . . . .	6		
B. Mini-REG Power, Fuse, and Alarm Panel . . . . .	8		
5. MINI-REG APPLICATIONS . . . . .	8		
6. INSTALLATION . . . . .	10		
7. TESTING AND MAINTENANCE . . . . .	10		
<b>Figures</b>			
1. Mini-REG Frames . . . . .	3		
2. Mini-REG Backplane . . . . .	4		
3. Comparison of 7A REG to 5A REG . . . . .	5		
4. 7A REG Block Diagram . . . . .	7		

CREG applications in 1/1A and 2/2B ESS\* switch.

- Negligible series impedance in idle or test mode compared to 200 ohms in earlier REGs.
- 10 M $\Omega$  dc resistance from each of tip and ring to ground in idle or test mode.
- Does not require the special 200 ms call-processing delay for 1/1A ESS switch as does the 5A and earlier REGs.

**1.05** The Mini-REG System can be used to treat all POTS loops between 1000 and 2800 ohms conductor loop resistance. Standard long route design rules should be followed for Mini-REG applications. Applications and limitations of application are discussed in detail in Part 5 of this section.

## 2. DESCRIPTION

### A. Mini-REG Bays, Frames, and Shelves

**2.01** The Mini-REG connectorized modular bay is an unequal flange cable duct framework equipped with mounting shelves; a power, fuse, and alarm panel; and backplanes.

**2.02** The mounting shelves serve as the support vehicle for the 7A REG plug-ins and the backplane assemblies. The plug-ins utilize edge-board connectors on the backplane. Interbay wiring utilizes quick-connect mass termination devices (ED-97932-30, GR1 rated Mfr Disc.) or hardwired backplane assemblies (ED-97932-30, GR2). The power, fuse, and alarm panel is provided with all the cabling necessary to accommodate the entire bay compliment of backplanes. To simplify coding, the same panel is used for the three different frames (J98631A, Lists 12, 13, and 14) that are available. The frames J98631A, Lists 1, 2, and 3 for connectorized backplanes are rated Mfr Disc.

**2.03** The frames with hardwired backplane assemblies are available in three different heights by list number:

J98631A, List 12—11 1/2 feet

J98631A, List 13—9 feet

\* Trademark of AT&T Technologies.

J98631A, List 14—7 feet.

The list number provides the frame complete except for backplanes; the power, fuse, and alarm panel; and 7A plug-ins. The power, fuse, and alarm panel is coded as J98631A, List 15.

**2.04** The J98631A, List 12 frame is equipped with 18 mounting shelves, and each shelf has 20 plug-in positions. This is a bay total of 360 plug-in positions or 720 range extension circuits. The J98631A, List 13 is equipped with 12 mounting shelves and has a bay total of 240 plug-in positions or 480 range extension circuits. The J98631A, List 14 is equipped with 10 mounting shelves and has a total of 200 plug-in positions or 400 range extension circuits. The Mini-REG frames are shown in Fig. 1.

**2.05** The backplane is the rear section of the shelf assembly that has been equipped with edge-board connectors for plug-ins. Figure 2 shows the connectorized backplane assembly (ED-97932-30, GR1) which is rated Mfr Disc. The standard hardwired backplane assembly (ED-97932-30, GR2) looks like the connectorized backplane, except it does not have the input/output connectors or the power connector as shown in Fig. 2. A backplane will accommodate two mounting shelves; the assembly occupies 13 vertical inches of bay space. Front covers to enclose the 7A REG plug-ins are furnished with the backplanes.

### B. 7A REG Plug-In

**2.06** The 7A REG is similar in function to the 5A REG. The 7A REG, however, consists of entirely new circuitry with thin-film and silicon integrated components. The 7A REG has two range extension circuits per unit and is assembled on an epoxy glass board and has a plastic faceplate. The plug-in is approximately 6 inches high, 10-1/2 inches deep, and 1 inch wide. The plug-in is shown in Fig. 3 alongside a 5A REG for comparison. The 5A REG contains one circuit per board; the 7A REG contains two range extension circuits in half the space.

**2.07** The 7A REG is programmed by straps between certain connector pins on the mounting backplane. In this manner the circuit is made to vary its short-loop threshold and its enabling mode to allow the same 7A REG design to serve both Mini-REG and CREG applications.

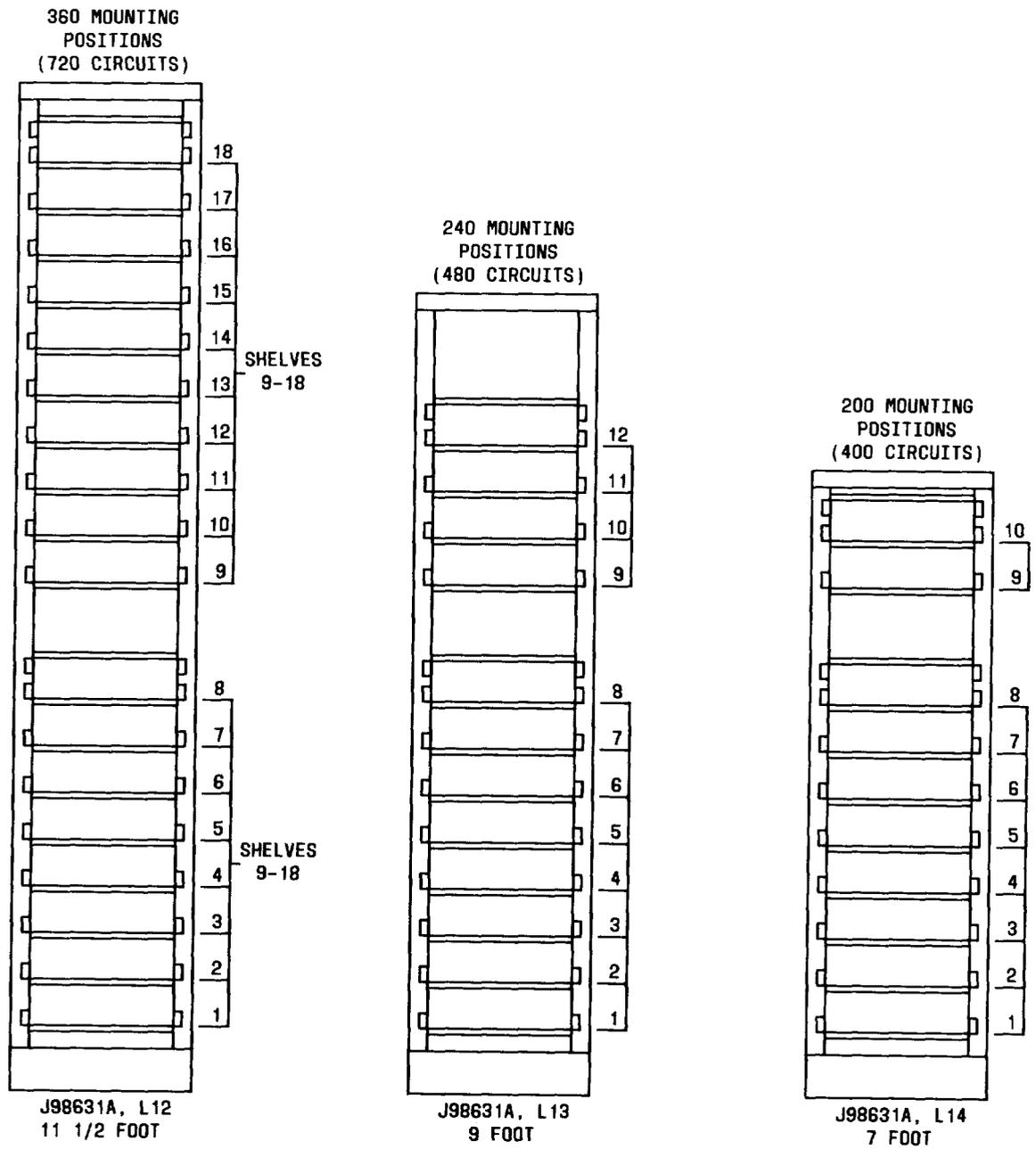


Fig. 1—Mini-REG Frames

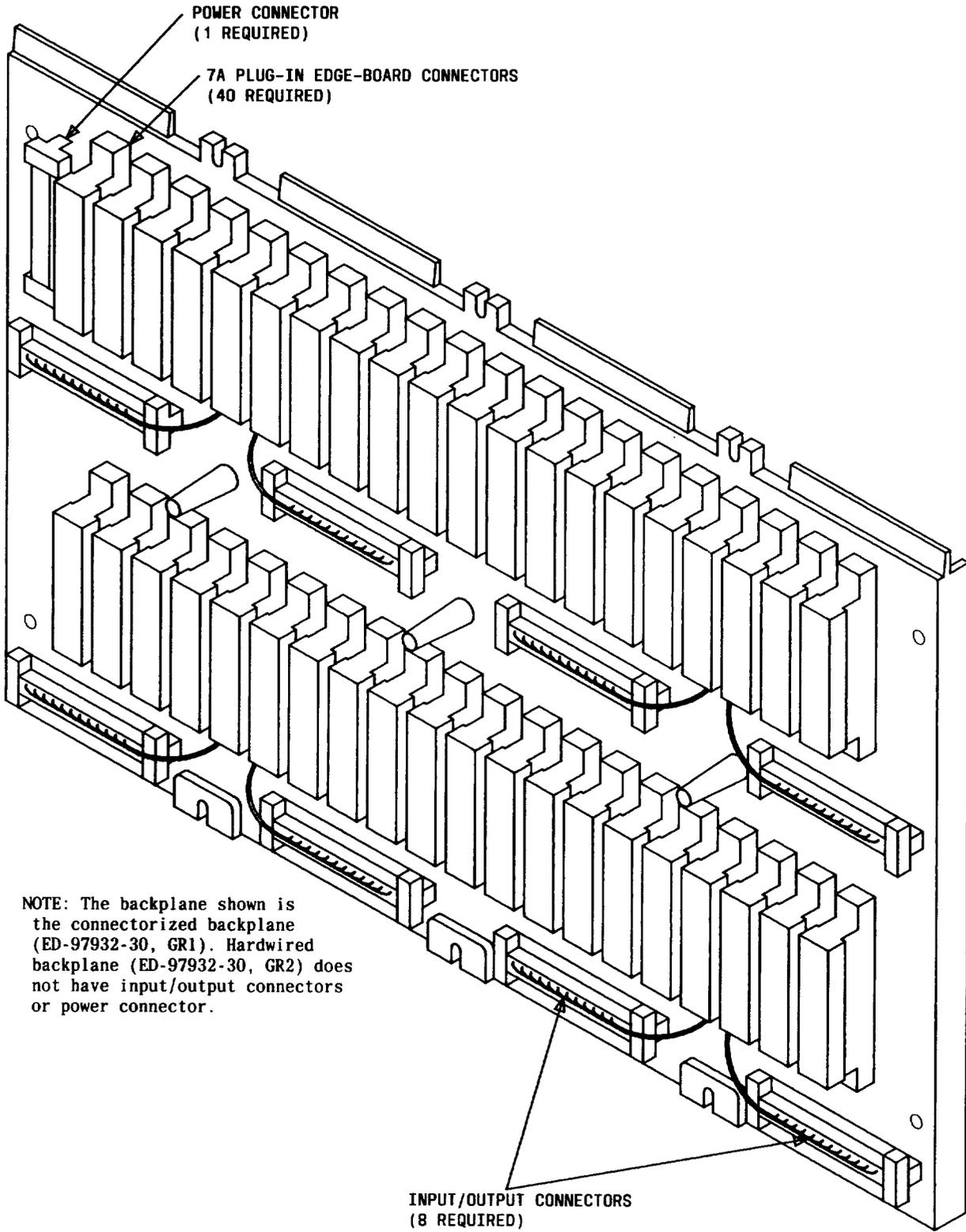


Fig. 2—Mini-REG Backplane (Note)

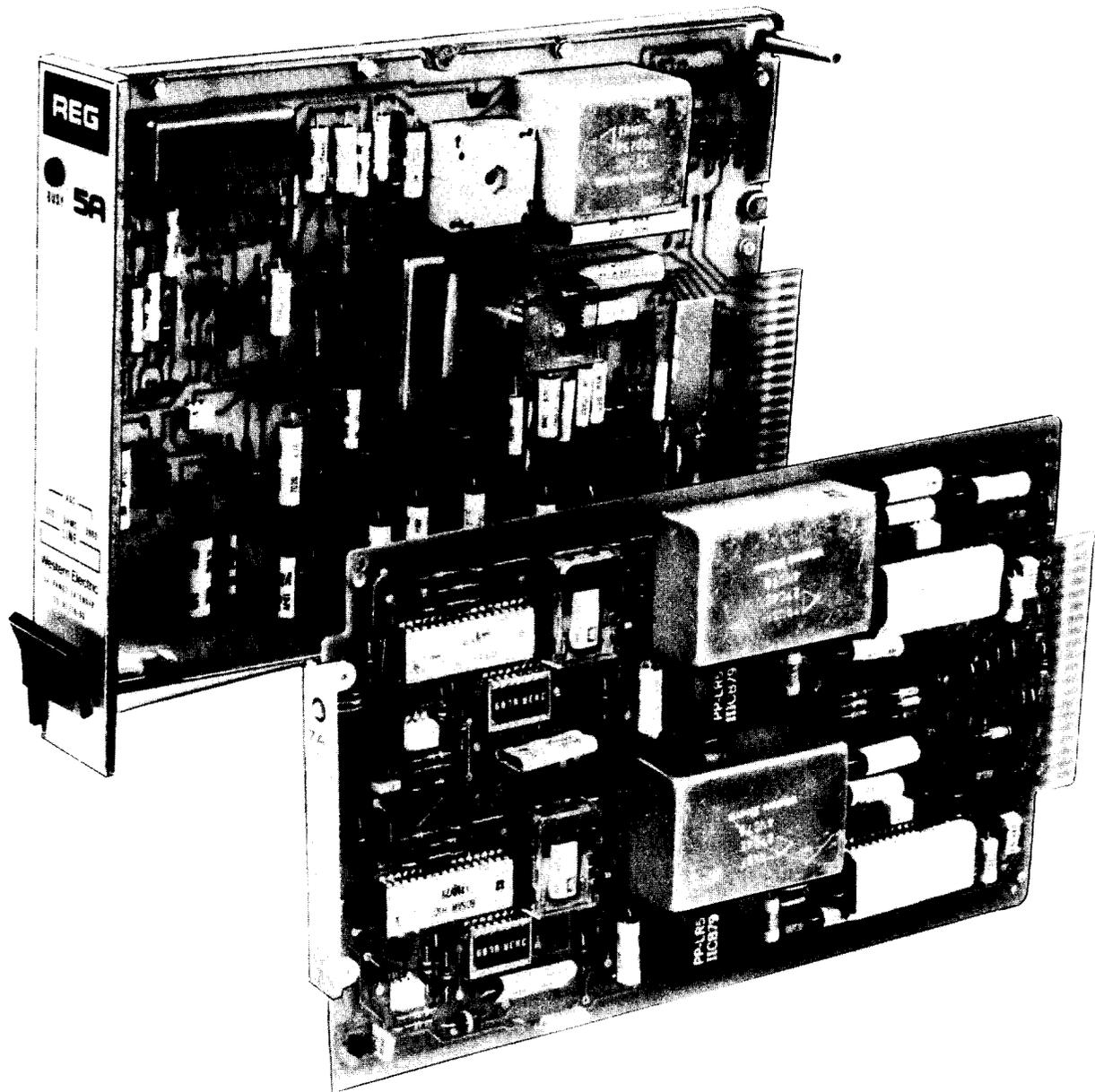


Fig. 3—Comparison of 7A REG to 5A REG

### 3. FUNCTIONS

#### A. Mini-REG System

3.01 The Mini-REG System is designed to perform the following functions when used on POTS circuits in a normal CO (central office) environment.

- Aid the operation of the CO line relay when the station goes off-hook.
- Detect dial pulses and aid the operation of the CO pulsing relay.
- Provide boosted loop battery ( $-78$  V dc) to ensure adequate telephone set current for

proper transmission and operation of TOUCH-TONE dials.

- Automatically adds 3 or 6 dB of VF gain to maintain proper transmission levels.
- Pass 20-Hz ringing signals without alteration.
- Aid the operation of the ring-tripping relay during the ringing or silent interval.
- Tolerate a reversal of loop current on the calling line when the called party answers.
- Allow direct access to the subscriber loop for tests by the party test relay used for ANI (automatic number identification), line insulation tests, and local test desk functions.
- Supply a universal line matching network to allow interfacing all loading loops having standard gauge combinations (no manual network settings).

**B. 7A REG as Mini-REG**

**3.02** All Mini-REG system functions with the exception of the boosted power supply, fusing, and alarms are provided by the 7A REG plug-in. For Mini-REG applications, the shelf backplane pins 9, 11, and 20 are shorted together; and pins 12 and 16 are shorted together. This provides completely automatic operation of the 7A REG and gain states as outlined below:

CONDUCTOR LOOP RESISTANCE (Ω)	GAIN (dB)
0—1000	Bypass state
1000—2000	3
2000—4100	6

**Note:** Conductor loop resistance is the resistance between the main distributing frame and the customer distribution terminal. The 7A REG actually measures total external circuit resistance that includes the customer's drop and station set resistances. These resistances have been taken into account in the 7A internal

circuit logic by assuming that they total 250 ohms.

**C. 7A REG for CREG Applications**

**3.03** When used as a CREG in 1 or 1A ESS switch, the 7A REG operates autonomously in a manner very similar to its Mini-REG application. Backplane straps are required between pins 8, 9, 11, 19, and 20 and between pins 12 and 16. In this mode the gain states are:

CONDUCTOR LOOP RESISTANCE (Ω)	GAIN (dB)
0—1500	Bypass state
1500—2000	3
2000—4100	6

**3.04** When used as a CREG in 2 or 2B ESS switch, the 7A REG operates in a semiautonomous manner under control of a peripheral decoder circuit. When the PD control is operated, the 7A REG operates autonomously in a manner similar to its Mini-REG application. When the PD control is unoperated, the 7A is in its bypass state. In this state the 2ESS switch performs the dial pulse detection and ring tripping with a loop range capability of 2800 ohms. This bypass state also occurs when the 7A REG's B-link is used for connecting to trunk or other non-POTS loops. For 2ESS switch CREG operation, 7A pins 8, 9, and 11 are connected together at the backplane. The gain states are:

CONDUCTOR LOOP RESISTANCE (Ω)	GAIN (dB)	
	PD UNOPERATED	PD OPERATED
0—1500	Bypass	Bypass
1500—2000	Bypass	3
2000—4100	Bypass	6

**4. OPERATION**

**A. 7A REG**

**4.01** Figure 4 is a block diagram of the 7A REG. The VF amplifier is an electronic hybrid

rather than a negative impedance device. The amplifier is switched into the circuit path by the operation of the RO (repeater operation) relay under control of circuit logic which utilizes four sensors as inputs. The primary sensors are the loop voltage and loop current sensors. These sensors provide measured loop voltage and current data to circuit logic to determine loop resistance. The result is compared with preset thresholds in the logic circuit, and a decision is made to force the bypass or allow the active state and, if active, to set the gain to either 3 or 6 dB. Basing the operation of the circuit on these resistance thresholds rather than on current thresholds makes the circuit respond to loop resistance independent of loop voltage.

**4.03** The CO voltage detector is used to determine the presence or absence of CO battery voltage. Absence of CO battery indicates that a tip party test is being performed or the CREG B-link is idle and causes the circuit to revert to its metallic bypass state.

**4.04** The ringing detector is used to detect the presence of CO ringing voltage. Its purpose is to prevent the circuit from going active (causing pretrip) on ringing voltage and current. The 7A does not repeat ringing but does assist ring trip when the station goes off-hook.

**4.05** In the bypass state, both off-hook origination and ring trip are aided by the loop (L) relay which places a shunt resistance across the office tip and ring conductors. In the ACTIVE state, dial pulses are repeated by operation of the loop relay which places the VF amplifier power supply acting as a load between tip and ring.

**4.06** In the ACTIVE state, the 7A also provides the loop with boosted battery (-78 V dc) through the repeat coil. The -78 V source is required to insure sufficient loop current to properly operate TOUCH-TONE dials and to power the station set out to 2800 ohms.

**4.07** The panel mounted busy lamp indicates a subscriber is off-hook and is receiving office cur-

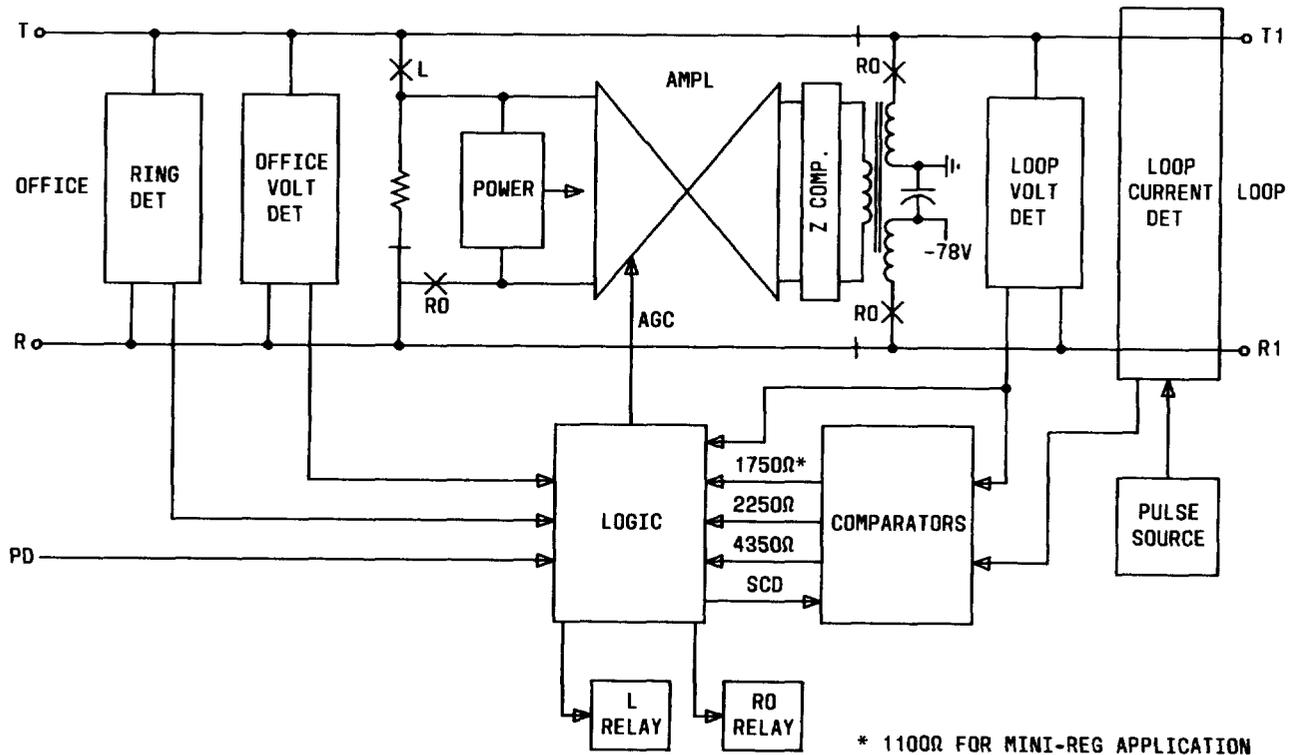


Fig. 4—7A REG Block Diagram

rent. The lamp indication is independent of whether the loop is long, requiring range extension, or is short and the REG is in the bypass mode. In 2/2B ESS switch CREG service, the 7A REG will occasionally be connected through the folded network to a service circuit. If this service circuit serves as a load, the associated REG busy lamp will properly indicate a busy condition. However, if the service circuit is a power source such as a CDPR (Customer Dial Pulse Receiver) or ringing circuit, the busy lamp will always remain off even if service is being provided.

**4.08** Power for all the circuitry except the amplifier in the 7A is derived from the -48 V dc office battery directly. The boosted loop supply is generated by two dc-to-dc converters in each bay. The amplifier circuitry derives its power from the supervisory circuit to which the 7A is connected.

#### **B. Mini-REG Power, Fuse, and Alarm Panel**

**4.09** The power, fuse, and alarm panel contains the bay fuses, alarm circuits, and power units as shown in Fig. 5. Each plug-in shelf of 7A REGs is protected by type 70 fuses. There is one fuse for the -48 V and one for the -78 V supplies to each shelf. The -78 V dc boosted battery is provided by a pair of 136K power units (dc-to-dc power converter units) in the panel. The outputs of these two units are paralleled through diodes internal to the power supplies.

**4.10** Two -48 V input buses provide powering for the bay. One bus feeds one power supply and the second bus powers the other. If one input bus and/or one power supply fails, the remaining input bus and power supply is capable of handling the full load requirements of the entire bay. This design provides redundancy and eliminates the need for a spare 136K power unit.

**4.11** This panel also provides major and minor alarm functions. A major alarm is caused by the failure of both -78 V power supplies, failure of both -78 V buses, or failure of a -48 V or -78 V shelf fuse. A minor alarm is caused by failure of one -78 V power supply or one input bus. No service is lost under minor alarm conditions. The major and minor alarm conditions are indicated by their respective red front panel lamps. A push-button ACO (alarm cutoff) switch allows cutoff of the audible major alarm. Operation of the ACO switch lights a white ACO status lamp. The circuit can be restored to normal condition through operation of the normal push-button. Both

136K power units have red indicator lamps to indicate power unit failures.

**4.12** Access to the fuses is from the front of the bay. The power units also plug into the panel from the front of the bay. All wiring and alarm circuitry is accessible from the rear of the bay. One panel code, J98631A, List 15, is used for all three bay heights.

**4.13** The CO -48 V battery is connected to the bay via a barrier-type terminal block located at the rear of the panel. Terminal punchings are furnished on the block for 14-gauge wire. The major and minor alarm connections (wire-wrap terminals) to the central office are also accessible from the rear of this panel.

#### **5. MINI-REG APPLICATIONS**

**5.01** The Mini-REG System can be used to treat all POTS loops between 1000 and 2800 ohms conductor loop resistance. It is compatible with individual single-party, 2-party, 4-party, and 8-party services. Functions associated with these services (e.g., ONI and ANI) are also compatible with the Mini-REG System.

**5.02** The 7A REG can be used with the 1 and 1A ESS switch without program modification. Previous REGs required an overwrite of the 1 or 1A ESS switch software to provide a 200-ms call processing delay before monitoring for dial pulses. The 7A uses faster internal relay timings and does not need this 200-ms delay.

**5.03** The Mini-REG System should not be used to treat subscribers in resistance zone 36. (Resistance zone 36 is 2800 to 3600 ohms conductor loop resistance.) Subscriber carrier should be used in lieu of VF range extension for loops that fall in resistance zone 36. Mini-REG applications should follow the long route design rules and administrative procedures described in Section 902-215-120.

**5.04** The 7A REG, as is the case with earlier REGs, may cause a hollow sound or singing condition when used on a reverse gauge loop consisting of both greater than 9 kft of 19-gauge cable at the CO end and greater than 15 kft of 26 gauge at the subscriber end. It is presently not compatible with the SD-31777-01 high resistance subscriber line circuit used in Step No. 355A, 356A, and 35E97 community dial offices.

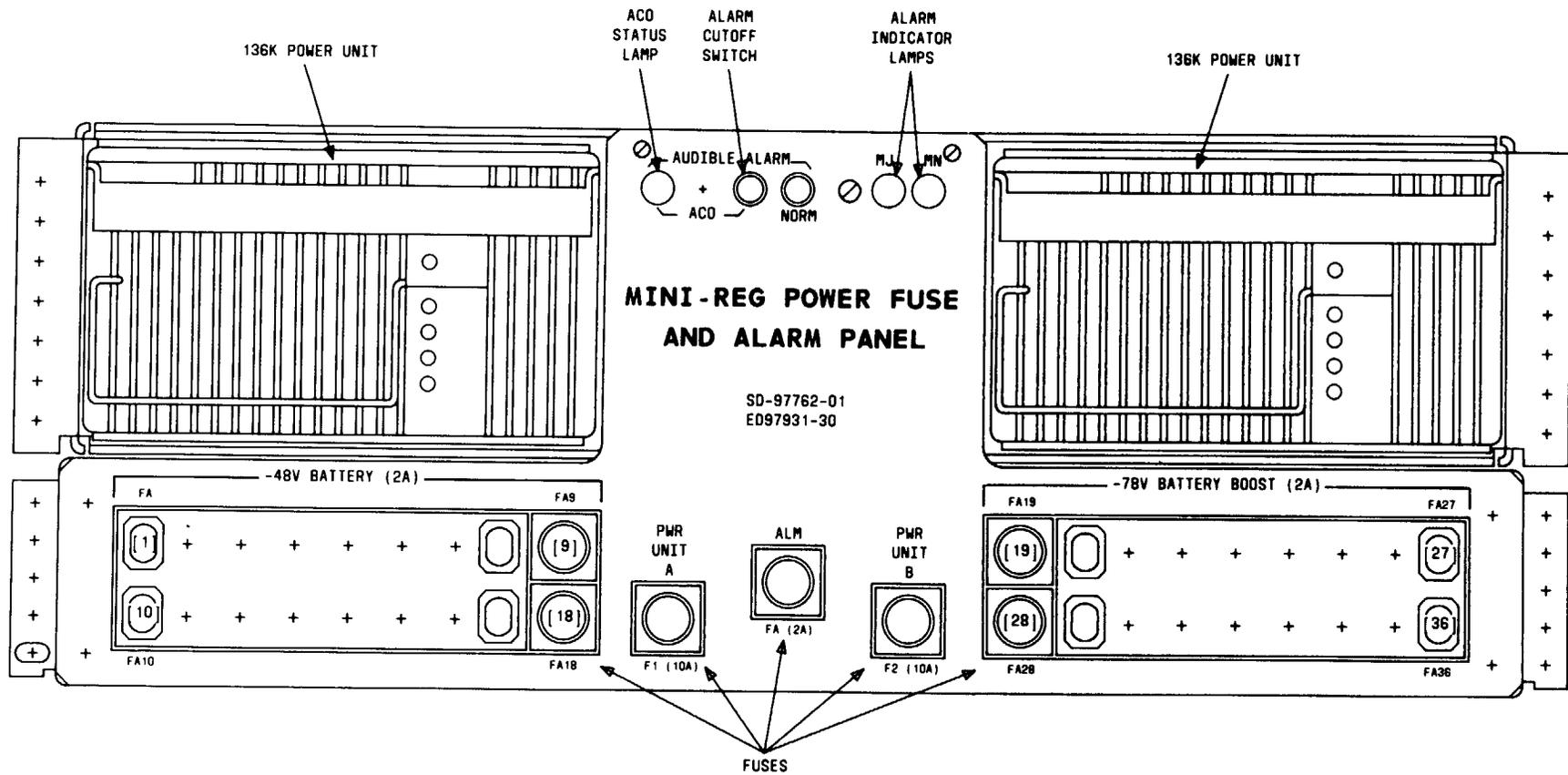


Fig. 5—Mini-REG Power Fuse and Alarm Panel

## 6. INSTALLATION

**6.01** When cabling a connectorized backplane (ED-97932-30, GR1 rated Mfr Disc.) installation, it is suggested that input and output leads be in separate cables to facilitate interoffice wiring, since separate input/output connectors are utilized on the backplanes. Breakouts should be made at each shelf position using bulk cabling.

**6.02** The hardwired backplanes (ED-97932-30, GR2) are completely mounted and wired for the entire frame at the factory. The power, fuse, and alarm panel also is assembled in the frame at the factory for J98631A, Lists 12, 13, and 14 frames.

## 7. TESTING AND MAINTENANCE

**7.01** The Mini-REG System's impact on loop maintenance is minimal. The procedures in Section 662-510-500 should be followed.

**7.02** For all normal testing, the 7A REG will be in the bypass state. This state exists when the tip-to-ring potential is less than 10 volts or when the loop current is less than 11 mA. In the bypass state, the 7A REG has less than 1-ohm series resistance; it has 10-megohms shunt resistance from tip-to-ground and 10 megohms from ring-to-ground. There is no direct resistance between tip and ring. Because of these characteristics, the 7A normally will be transparent to the local test desk or in line insulation tests.

**7.03** Test for TOUCH-TONE dial reversal will result in abnormal responses, because the loop must be closed and the 7A must be active. When active, the 7A does not repeat battery polarity reversals. An MDF (main distributing frame) test shoe can be used to bypass the REG as required.

**7.04** In the range where the 7A REG goes active, the test desk cannot measure loop resistance using the 24 mA key approach. The 24 V key can be used to measure tip and ring resistances where a lesser degree of accuracy is required. Also, the test desk will measure loop resistance incorrectly when a leakage resistance below 5000 ohms, as from a wet cable, causes the REG to go active.

**7.05** The 7A REG is not physically compatible with the 141A test set designed for use with previous REGs. Installation and maintenance testing of the 7A is a go-no-go type with no detailed measurements required. The 7A REGs may be tested in place with the KS-21940, L1 handset adapter in combination with the 1014 maintenance handset. The adapter, which was designed for use with earlier REGs, has a minor limitation when used on the 7A. The limitation is that the adapter has a feature to indicate the presence of boosted battery which is marginal when used on the 7A with the adapter in the terminating mode.