TYPE N2 CARRIER TELEPHONE SYSTEM
J99272 CARRIER TERMINAL EQUIPMENT FOR NONPACKAGED BAYS
GENERAL DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section describes the plug-in units, mounting shelves, and common equipment which comprise a J99272 terminal of the N2 carrier telephone system when that terminal is not mounted in a packaged bay.

1.02 This section is reissued to include references to the J99272BW line terminating unit, the J87216C power supply unit, and to revise references to wideband modem units.

1.03 The N2 carrier system employs transmitted carrier double-sideband transmission with channels spaced every 8 kHz. For most installations, 12 channels, numbered 2 through 13, transmit carriers at 8-kHz intervals from 176 kHz through 264 kHz (high group) in one direction of transmission, and from 40 kHz through 128 kHz (low group) in the opposite direction of transmission. Figure 1 shows a photograph of an N2 terminal. A channel 1 is available for use in place of any other channel which may be unavailable because its frequency band is used for wideband data service, or is unsatisfactory due to interference. Channel 1 may also be used as a maintenance spare to replace temporarily any channel in trouble because of a defective channel modem unit. Use of channel 1 as a maintenance spare reduces the required stock of spare equipment. Channel 1 has a 168-kHz carrier for high-group transmission and a 136-kHz carrier for low-group transmission. All carrier channels are generated and detected in the high-group range to simplify filters and other elements. However, since they may be transmitted over the line at either high-group or low-group frequencies, a low-group range is obtained by group modulation with a 304-kHz carrier, the lower sideband being selected by filters. When low-group frequencies are received, they are modulated with a 304-kHz carrier and filtered to select the lower sideband to obtain the high-group frequencies required by the channel demodulators.

1.04 The N2 carrier terminal equipment is intended for use with N1 electron tube repeaters and N1A or N2 transistorized repeaters. 240-type transistorized flat-gain amplifiers may also be used on the line. Power for repeaters and flat-gain amplifiers may be supplied as direct current over the simplexes of the same two cable pairs used for the carrier signals. When electron tube repeaters are used power may be supplied to one repeater, and when transistorized repeaters are used power may be supplied to as many as four repeaters in some instances. Further details on repeater powering arrangements may be found in the associated Plant Series sections and on SD-97272-01.

1.05 N2 carrier terminals are arranged for use only with inband external E-type single-frequency signaling. Automatic trunk conditioning equipment, including the carrier group alarm (CGA) unit and CGA signal receiver, must be associated with each

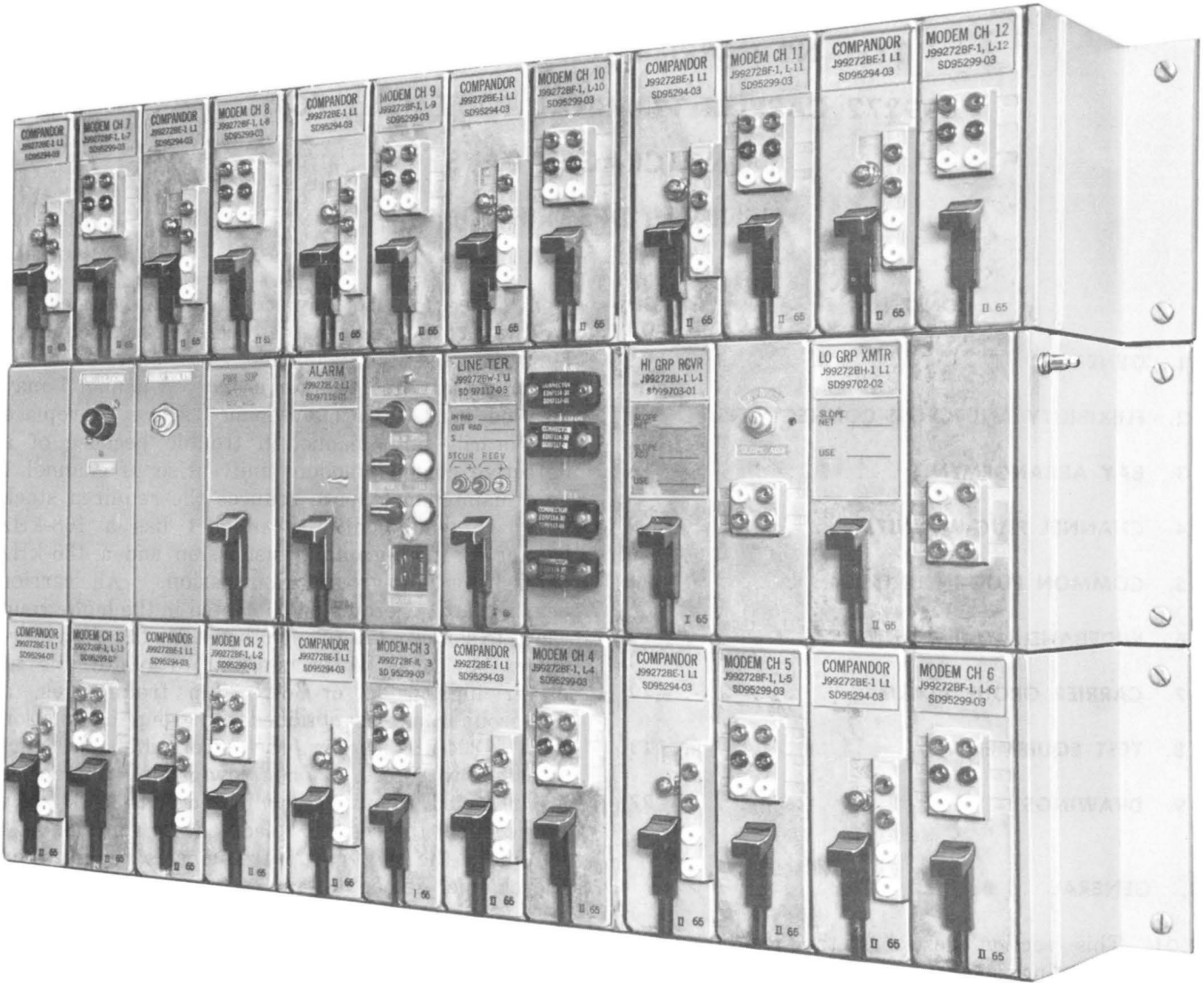
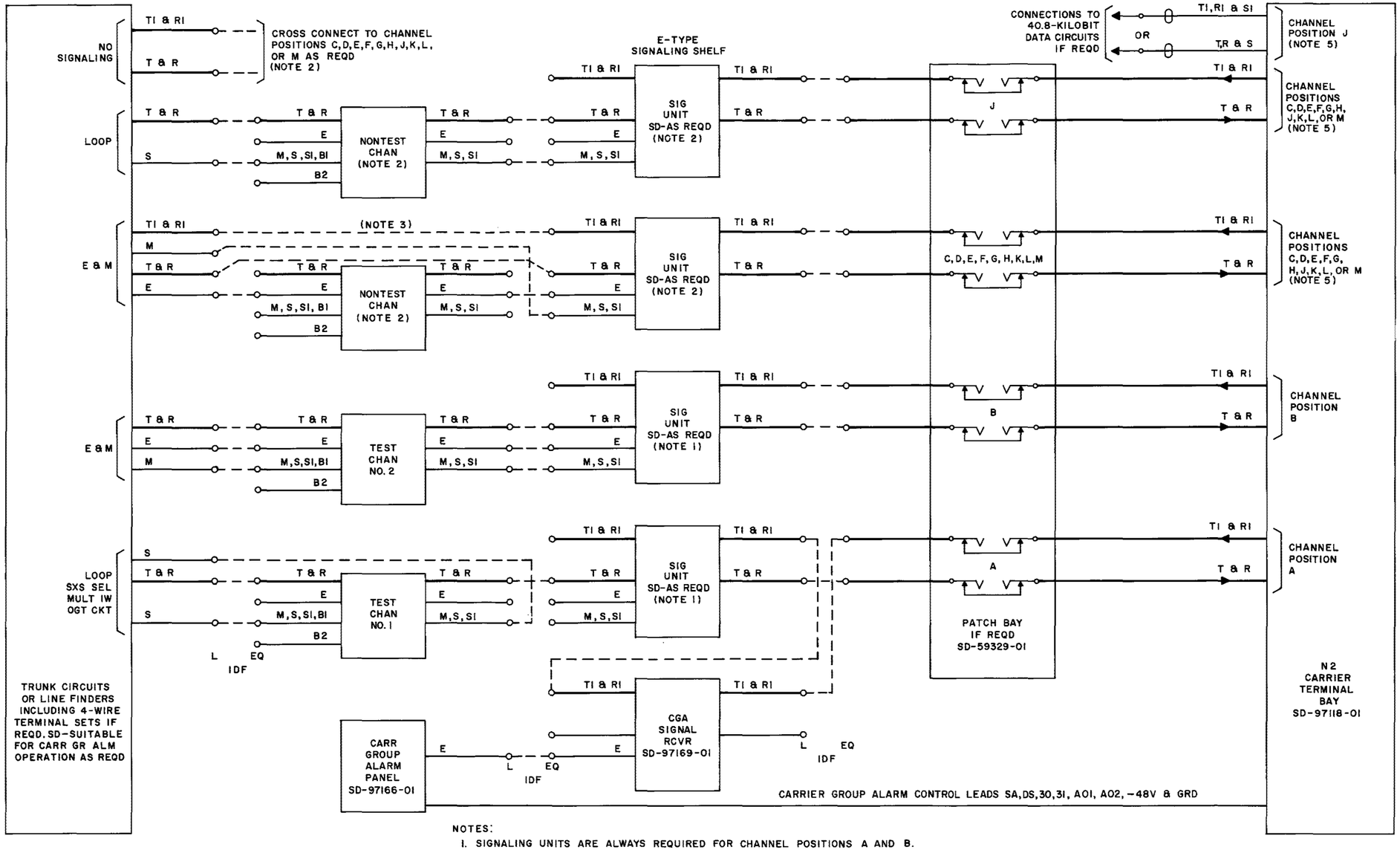


Fig. 1—N2 Carrier Terminal—Front View

terminal and the E-type signaling equipment associated with it. The message channels using channel positions A and B must be connected to the E-type signaling units at the carrier terminal offices. These units and the CGA signal receivers at the terminals are required to control the service restoral control circuit in the carrier group alarm equipment. Other message channel positions may or may not be associated with signaling. The carrier group alarm equipment is located in miscellaneous bay space outside the terminal bay. The CGA signal receiver is located in an E-type signaling unit bay. Either 4-wire terminating circuits, included in some E-type signaling units, or separate 4-wire terminating sets may be used with N2 carrier channels, depending upon circuit requirements. Figure 2 shows a typical interconnection of N2 carrier terminal bays, carrier group alarm equipment, CGA signal receiver, and E-type single-frequency signaling equipment. The optional use of 4-wire terminating sets and voice-frequency patching bay equipment is also shown.

1.06 A complete N2 carrier terminal requires not only part of a shop-wired terminal bay with associated plug-in units but also two or more E-type signaling units, a CGA unit, a CGA signal receiver, and numerous trunk circuits. For the purposes of



NOTES:

1. SIGNALING UNITS ARE ALWAYS REQUIRED FOR CHANNEL POSITIONS A AND B.
2. SIGNALING UNITS AND ASSOCIATED SECTION OF CARRIER GROUP ALARM ARE BYPASSED AT THE IDF FOR CHANNEL POSITIONS C TO M NOT REQUIRING TRUNK CONDITIONING OR SIGNALING AT THE N2 TERMINAL OFFICE.
3. RUN THESE TI AND RI CONNECTIONS WHEN REQUIRED FOR 4-WIRE OPERATION.
4. – – – DENOTES CROSS-CONNECTION WIRES.
5. IF WIDEBAND DATA IS REQUIRED, CHANNEL POSITION J WILL USE SHIELDED WIRE AND BE CONNECTED DIRECTLY TO THE WIDEBAND DISTRIBUTING FRAME.

Fig. 2—N2 Carrier Terminal—Typical Connections for Message Use—Block Diagram

this section, trunk circuits are defined as connections to switching circuits, subscriber lines, or voice-frequency extensions to other offices. They may be 2-wire or 4-wire with or without 4-wire terminating sets, but each may be reached via suitable transmission and signaling connections at a distributing frame. The circuit derived from each of the 12 channel positions in an N2 terminal may be used for a wide variety of purposes. The circuit may require different types of plug-in units, different E-type signaling units (which may be omitted), and connections through or around sections of the CGA unit as well as different trunk circuits.

2. FLEXIBILITY AND CROSS-CONNECTIONS

2.01 It is seldom possible to predetermine the specific arrangements for each channel when an installation is engineered. Reassignment of channels from time to time is a common occurrence. Accordingly, the main circuits are connected to a distributing frame by universal cabling so that they may be interconnected or bypassed by suitable cross-connections. This provision and optional strapping at terminal blocks on the CGA unit make possible office engineering and subsequent assignment or reassignment of channels to services and trunks without additional engineering or installer effort. Figure 2 illustrates typical interconnections between channel positions and trunk circuits. Reference to Fig. 2 will be useful in the following discussions of flexibility and interconnections.

2.02 Both the J99272 carrier terminal bays discussed in this section and the J99285 packaged bays discussed in Section 362-801-101 provide the same flexibility between channel positions, E-type signaling units, and trunk circuits. However, most of the flexibility and interconnections shown in Fig. 2 are provided within the packaged frames, with a subsequent saving in distributing frame space and installer cabling.

2.03 The compressor input leads (T and R) and the expandor output leads (T1 and R1) of channel positions A through M in the N2 terminal bay are connected to the intermediate distributing frame (IDF) either directly or via a patching and monitoring bay when centralized testing and interchange of carrier channels are desired. For message use, the input and output pairs for all channel positions (including channel position J) are connected in the same manner. The special handling of the channel position J connections for 40.8-kilobit data use is discussed in 2.09.

2.04 The input (T1 and R1) and output (T and R) leads on the line side of the E-type signaling units are also connected to the IDF. In like manner, the line and equipment side connections to the CGA signal receiver are connected to the IDF. As illustrated in Fig. 2, both line and equipment connections are T1 and R1 leads corresponding to 12-wire universal cabling to the E-type signaling positions. If the office uses 7-wire or 8-wire cabling, the leads from the CGA signal receiver to the EQ block on the IDF would be designated T and R rather than T1 and R1, but they would be cross-connected to T1 and R1 leads on the L block for the E-type signaling unit in test channel No. 1. This flexibility between channel positions and E-type signaling units facilitates rearrangements for purposes such as the following:

(a) Omission of signaling units on channel positions C through M arranged for through signaling, program, or other special services.

(b) Reassignment of E-type signaling unit positions to accommodate auxiliary signaling units E1L-A and E1S-A.

(c) Use of the CGA signal receiver on test channel No. 1. It should be noted that the cabling to and from E-type signaling shelves may not meet the transmission requirements of some of these services, and routing through connectors plugged into E-type signaling unit shelves would not be desirable.

2.05 The equipment side of each E-type signaling unit position is connected to an EQ block on the IDF by T and R and two supervision leads E and either M, S, or S1. The line side of each test channel or nontest channel block on the CGA unit is connected to an L block on the IDF by T and R, E, and either M, S, or S1 leads. One or more of these leads may be cross-connected to an E-type signaling unit as required by the type of trunk circuit, type of signaling unit, and test or nontest assignment of the channel. In many assignments, some of these leads are cross-connected to trunk circuits and routing via the CGA unit would not be satisfactory for transmission and/or supervision reasons. Only the leads requiring CGA processing in the particular assignment are routed through the CGA unit. An example in Fig. 2 shows T and R and M leads for the nontest channel with E and M signaling connected directly to the trunk circuit rather than through the CGA

unit. Only the E lead is connected through the CGA unit. It may be noted in the example used for test channel No. 1 that in some instances, the CGA S lead at the L block on the IDF is cross-connected to an S lead on the trunk circuit rather than to an S lead on the EQ block for an E-type signaling unit; i.e., the S leads of the CGA are in series with two parts of the trunk circuit.

2.06 Each test or nontest channel block on the CGA unit is connected to an EQ block on the IDF by T and R, E, B2, and either M, S, S1, or B1 leads. There are only five leads from each CGA block but one of them has multiple designations as shown in Fig. 2. In some assignments, all five leads are cross-connected to a trunk circuit but, in other assignments, as few as one lead may be used. Use of channel positions C through M for message channels without signaling, program, or some special services requires direct cross-connection from the EQ block on the IDF associated with the N2 terminal channel positions discussed in 2.03 and the L block on the IDF associated with the trunk circuit. These connections are illustrated at the top of Fig. 2.

2.07 In many assignments such as nontest channels when E and M lead supervision is used, the T and R leads and the M lead do not require processing in the CGA unit. Accordingly, cross-connections are often required from the EQ block on the IDF associated with the E-type signaling units to the L block on the IDF associated with the trunk circuits. The 4-wire to 4-wire signaling units, such as E1B, E2B, and E3B, use T1 and R1 leads which do not require processing in the CGA unit and are cross-connected directly to the trunk circuit as shown on a nontest channel in Fig. 2.

2.08 In locations where signal LINE and EQ jacks are wired in the E and M leads, these jacks would be wired on the equipment side of the CGA circuit (if used) or on the equipment side of the E-type signaling unit.

2.09 As discussed in 2.03, the input (T and R) and the output (T1 and R1) pairs for channel position J are used alternately for message or 40.8-kilobit data service and are shielded within the N2 terminal bay. For message use, the channel position J pairs between the N2 terminal bay and the IDF should be connected in the same manner as all other channel position pairs and need not be shielded. When used for data, shielding is required and these leads should not be routed through a patching bay or IDF but run directly to the wideband service bay for transmission and operating reasons. When converting from message to data service, the channel position J pairs must be disconnected at the bay terminal strips and shielded cables connected between the wideband service bay and the N2 bay terminal strips.

2.10 For complete cross-connection information, refer to the functional schematic diagrams and the cross-connection table on SD-97166-01 Carrier Group Alarm Circuit.

3. BAY ARRANGEMENTS

3.01 The N2 terminal bays using bulb-angle framework (Fig. 3) are arranged to mount eight 12-channel terminals in the 11-foot 6-inch bay or six 12-channel terminals in the 9-foot bay. The N2 terminal bays using duct-type frames (Fig. 4) are arranged to mount up to four 12-channel terminals in a single 7-foot bay or up to eight 12-channel terminals in a double 7-foot bay. Completely shop-wired packaged terminal bays (J99285) are described in Section 362-801-101 and are not discussed in this section. The J99272 bays (Fig. 3 and 4) include the mounting shelves for the plug-in units and common equipment consisting of a bay cable terminating unit and a miscellaneous jack and alarm panel. Each N2 terminal includes three die-cast shelves for mounting 12 compandor units, 12 channel modem units, a group transmitting unit, a group receiving unit, a line terminating unit, an alarm unit, and a power supply unit. Figure 5 is a block diagram showing the interconnection of these units in an N2 carrier terminal. Plug-in units using printed wiring assemblies supersede the earlier production poured-epoxy assemblies (Amplas). Table A lists the various J-coded plug-in units required. Figure 1 shows an assembly of three shelves equipped with plug-in units in normal positions as follows: six compandor units and channel modem units mounted in channel positions A through F in the bottom shelf; six compandor units and channel modem units in channel positions G through M in the top shelf; and the power supply, alarm, line terminating, and group units in the center shelf.

3.02 Each of the shelves in a terminal is equipped with connectors to mate with plugs on the appropriate plug-in units. Wiring to the connectors on the rear of the shelf is formed into two flexible

TABLE A

TYPE OF SERVICE	PLUG-IN UNIT			REQUIRED
	TITLE		CODE	
All	Power Supply		J87216A or C	One per terminal
	Alarm		J99272L or BL	One per terminal
	Alarm Link		J99272AY	One per unequipped terminal (see notes under frame codes)
	Line Terminating		J99272M, BM, or BW	One per terminal
	Group Transmitting	High	J99272G or BG	One per terminal
		Low	J99272H or BH	
	Group Receiving	High	J99272J, AJ, or BJ	One per terminal
		Low	J99272K, AK, or BK	
	3-channel Power Load		J99272AE	One per three unused channels
Message	Compandor		J99272E or BE	One per channel (channel positions A to M)
	Modem		J99272F or BF	One per channel (channel positions A to M)
	VF Amplifier		J99272AA, BA, or BD	One per channel not requiring compandoring action (channel positions A to M)
Schedule C & D Program	Compandor		J99272AF or BE	One per channel (channel positions A to M)
	Modem		J99272AG	One per channel (channel positions A to M)

cable arms, one on each side. In bulb-angle bays, sufficient slack is provided in these arms between cable clamps on the shelf and the vertical bay cables to permit sliding a shelf forward and tilting it face-down where it will be supported by a maintenance support assembly. This arrangement affords access to the connectors for maintenance when terminal bays are located against a wall or in a back-to-back line-up. Terminals mounted on duct-type frames require access to both sides for maintenance and cannot be mounted back-to-back or back-to-wall.

3.03 The bay cable terminating unit provides terminal strips for connections to other equipment, power supply fuses for the carrier terminals, fuses and associated resistors for power feed to distant repeaters, and alarm equipment common to the bay. The alarm equipment includes relays controlling office alarms for fuse failures, carrier failure, and -21 volt power supply deviation. Provision is made for supplying odd- and even-numbered carrier terminals from separate power feeders.

3.04 The miscellaneous jack and alarm panel provides jack appearances for the office 1000-Hz 1-milliwatt testing power and for the N carrier maintenance telephone circuit. It also includes a circuit which gives an alarm indication by means of a local lamp and by connection through

LEGEND

TERMINAL POSITION	UNIT	MFR DISC. CODES	AT&TCO STD CODES
CO	Message Compandor Unit	J99272E	J99272BE
	Schedule C and D Program Compandor Unit	J99272AF	
	Voice-Frequency Amplifier Unit	J99272AA, BA	J99272BD
MO	Message Channel Modem Unit	J99272F	J99272BF
	Schedule C and D Program Modem Unit	–	J99272AG
RCVR	High-Group Receiving Unit	J99272J, AJ	J99272BJ
	Low-Group Receiving Unit	J99272K, AK	J99272BK
XMTR	High-Group Transmitting Unit	J99272G	J99272BG
	Low-Group Transmitting Unit	J99272H	J99272BH
ALM	Alarm Unit	J99272L	J99272BL
LINE T	Line Terminating Unit	J99272M, BM	J99272BW
PWR	Power Supply Unit	J87216A	J87216C

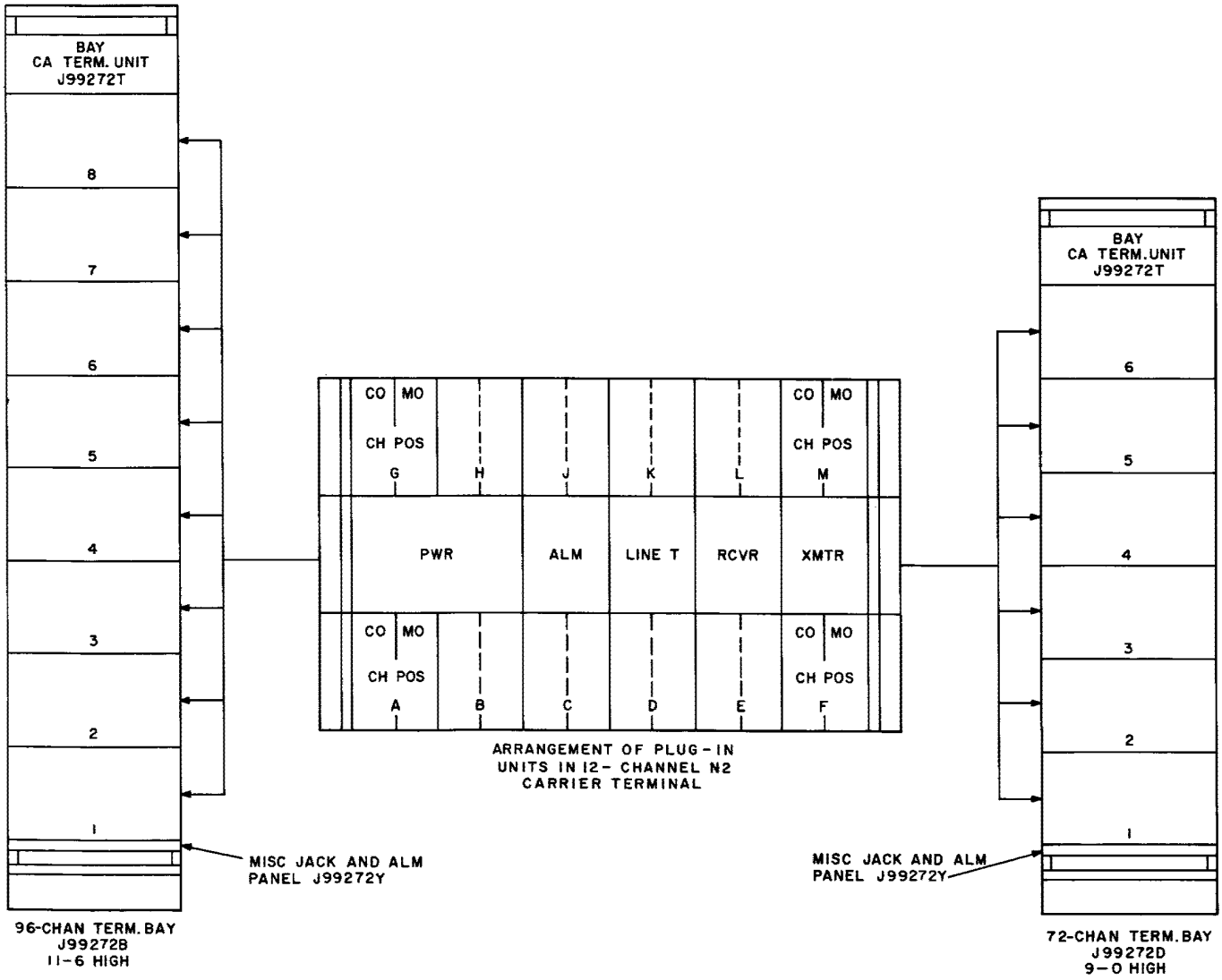


Fig. 3 — Shop-Wired N2 Carrier Terminal Bays — Typical Bay Arrangements

the bay alarm circuit to the office alarm system when one of the plug-in alarm units in the bay is removed. The office alarm may be released by operating a key on the panel, but the local lamp remains lighted until all alarm units are in place, or until J99272AY alarm link units or suitably strapped connectors are substituted for them. The coded unit serves the same function as the strapped connector but is more satisfactory from a maintenance standpoint. Such a connector is included in each terminal at the factory. This permits alarm panel operation before all terminals are equipped with plug-in units. Where provided, -48 volt fuses for power supply to carrier line repeaters are located in this panel.

4. CHANNEL PLUG-IN UNITS

Compandor Unit

4.01 A compandor unit (Fig. 6) is a single-module wide plug-in unit provided for each channel where compandor action is required. A unit (J99272BE) suitable for both message and schedule C and D program service replaces the two older units formerly provided for these services (J99272E and J99272AF, respectively). The same compandor unit is suitable for use with any numbered channel. Included in this unit are:

(a) A compressor circuit which reduces the volume range of the voice-frequency signal before modulation in the transmitting terminal.

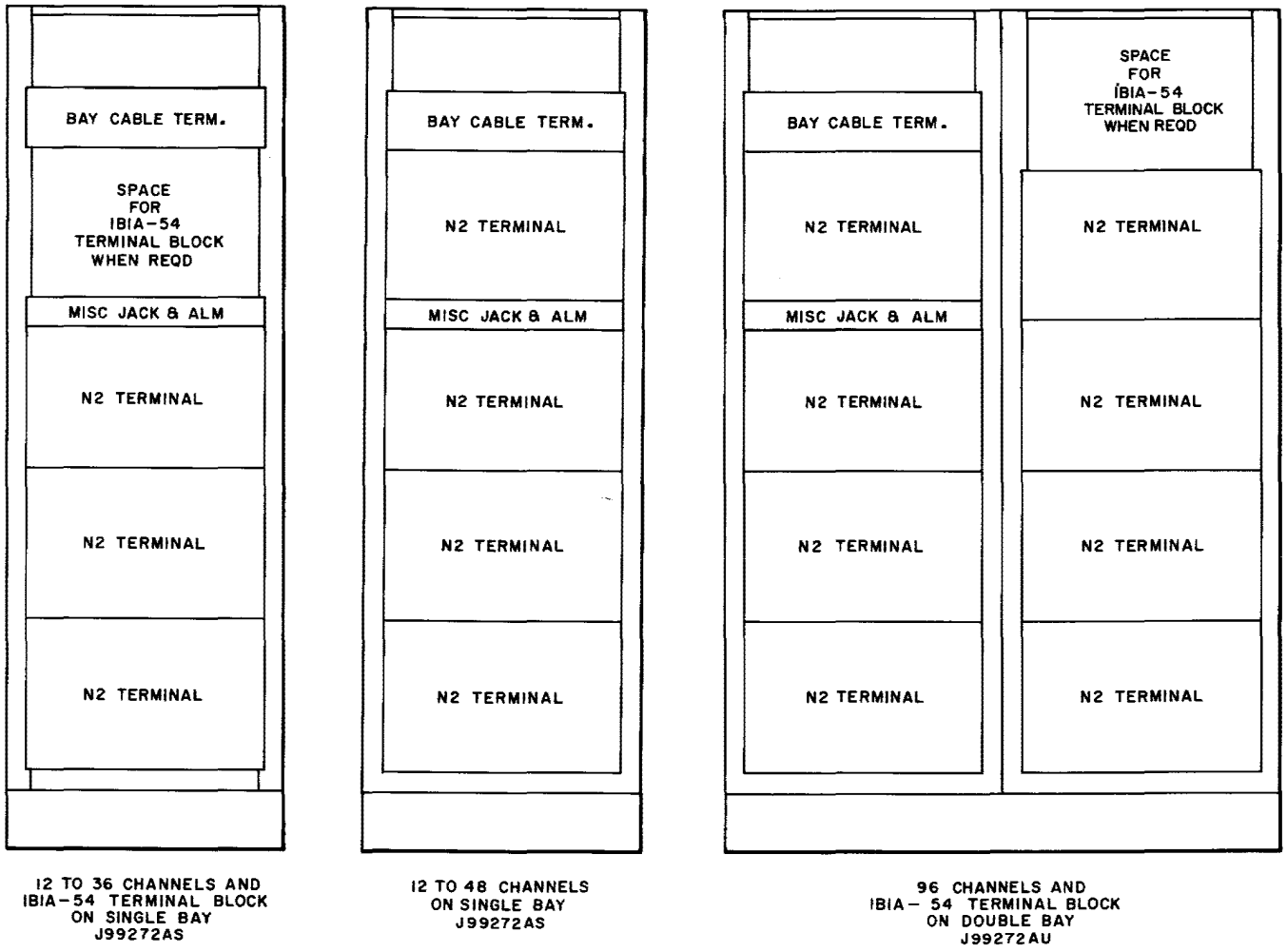


Fig. 4—Shop-Wired N2 Carrier—Only Bays Using 7-Foot by 23-Inch Duct-Type Frame—Bay Arrangements

(b) An expandor circuit which restores the volume range of the signal after demodulation in the receiving terminal. The expandor circuit includes an output adjustment potentiometer which is accessible on the face of the unit. Four pin jacks are provided on the face of the unit for use with test equipment to monitor and measure the level at the voice-frequency input and output. These pin jacks may also be used for a modified 52K headset or a new 52T headset when an out-of-service channel is used for a temporary talking circuit.

Message Channel Modem Unit

4.02 The message channel modem unit (Fig. 7) is a single-module wide plug-in unit which is required for each channel (except program channels). There are two versions of the message channel modem unit: J99272F modified for crystal filter or with LC filter and Amplas subassembly, and J99272BF with crystal filter and printed wiring assembly. There are 13 different units under each of these codes, one for each channel frequency. Each channel modem unit includes two complementary devices: a modulator circuit and associated oscillator, and a demodulator circuit and associated regulator. The modulator circuit receives voice-frequency signals from the compressor and translates them to a double-sideband carrier-frequency signal in an 8-kHz band within the high-group frequency range of 164 through 268 kHz. The demodulator circuit selects its specific 8-kHz wide channel from the 12 high-group carrier channels received from the group receiving unit. Then the selected channel signals pass through a regulating amplifier to the demodulator and are modulated down to voice frequency for transmission to the expandor. A complete terminal may be equipped for 12 channels, generally utilizing channels 2 through 13, as shown in Fig. 1. As noted in 1.03, channel 1 may be substituted for any one of these channels. Test points are provided on the face of the channel modem unit for use in measuring:

(a) Modulator input level (voice).

(b) Modulator output level (carrier).

(c) Level at the output of the receiving channel bandpass filter (carrier).

(d) Demodulator output level (voice).

Schedule C and D Program Channel Modem Unit

4.03 The J99272AG schedule C and D program channel modem unit may be used instead of a message channel modem unit to provide schedule C or D program service. They cannot be placed in channel position A or B because they are not compatible with the signaling associated with those positions. The 21-volt power required for these units is approximately the same as that of the replaced message channel modem units. Schedule C and D program channels may be located at carrier frequencies for channels 3, 4, 5, 6, or 7 if N2WM-1 wideband data service is not required. Only channel 3 may be used for schedule C and D program if N2WM-1 data service is provided and alternate voice use is not required.

4.04 The channel modem unit for schedule C and D program (Fig. 8) is a single-module wide plug-in unit. There are five separate channel modem units, one for each of the carrier-frequency channels 3 through 7. Each channel modem unit includes a modulator circuit and associated oscillator and a demodulator circuit and associated regulator. The modulator circuit receives voice-frequency signals from a compressor and translates them to a double sideband carrier-frequency signal in an 8-kHz band within the high-group frequency range of 180 to 220 kHz. The demodulator circuit selects its specific 8-kHz wide channel from the 12 high-group carrier channels received from the group receiving unit. The selected channel signal then passes through the regulating amplifier and is demodulated down to voice frequencies for transmission to an expandor. Test points are provided on the face of the unit for use in measuring: (a) modulator input level (voice), (b) modulator output level (carrier), (c) level at the output of the demodulator input band filter (carrier), and (d) demodulator output level (voice).

Voice-Frequency Amplifier

4.05 The voice-frequency amplifier (Fig. 9) is a single-module wide plug-in unit interchangeable with a compandor unit in regard to size, external connections, and power requirements. There are three versions of this unit:

(a) J99272AA, an Amplas assembly for through-channel use on message trunks.

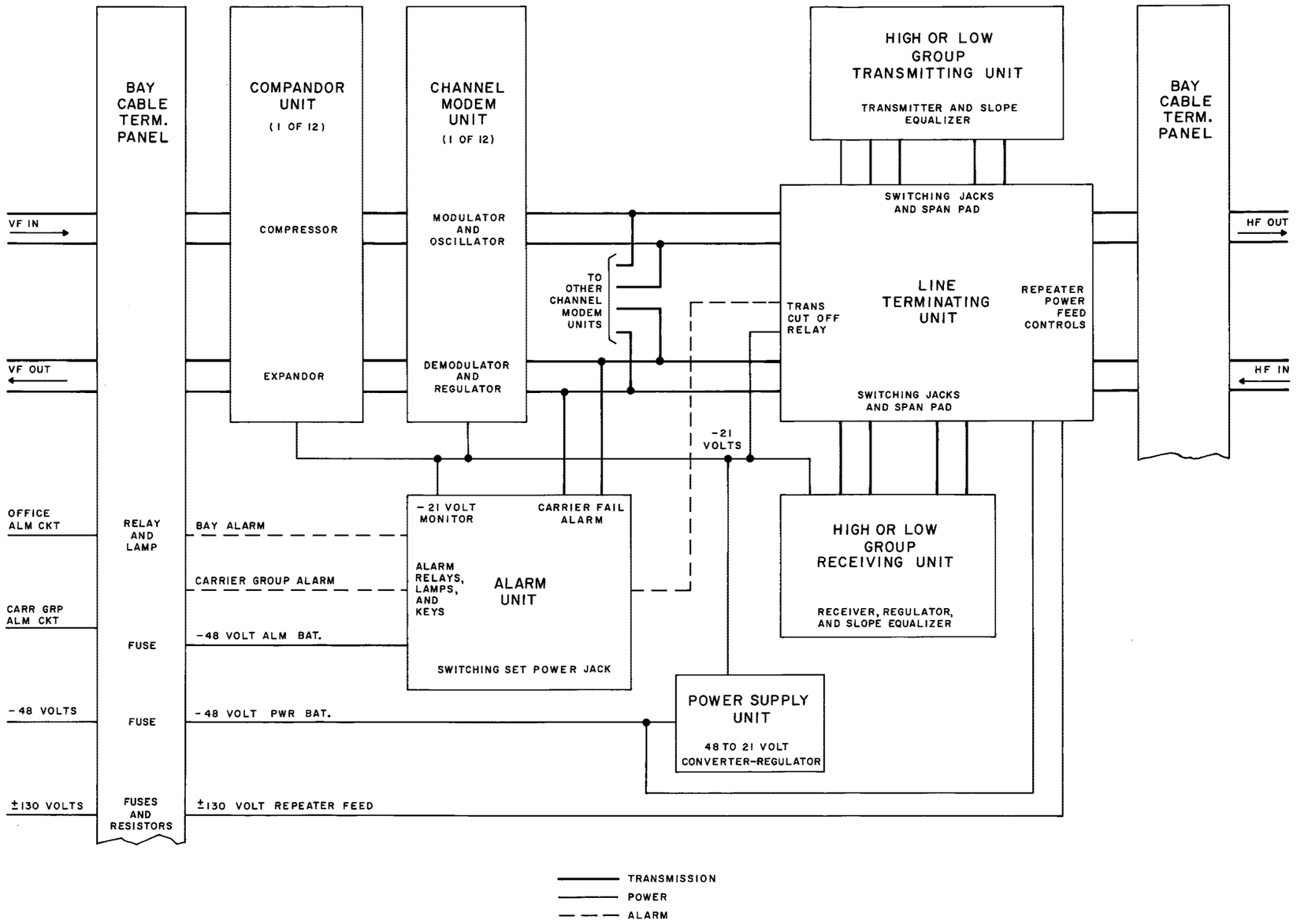


Fig. 5—N2 Carrier Terminal Arranged for Message Use—Block Diagram

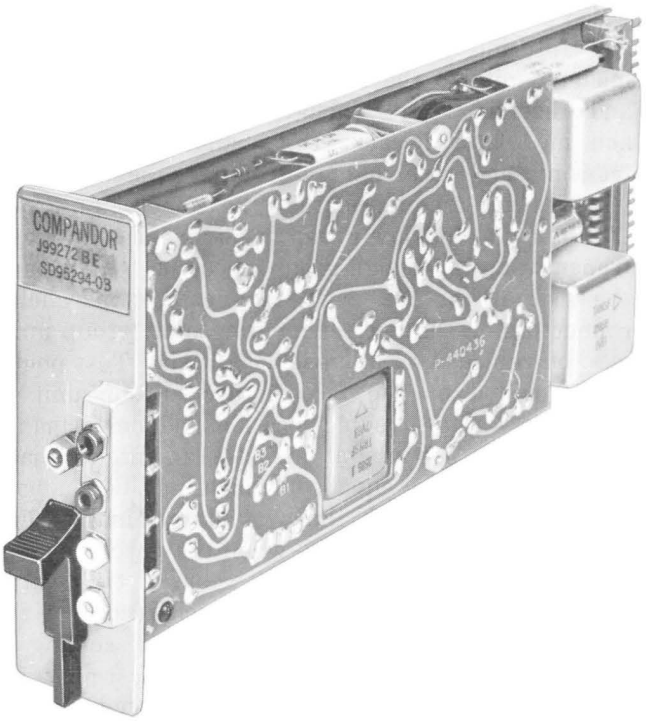


Fig. 6—Compandor Unit—Front View

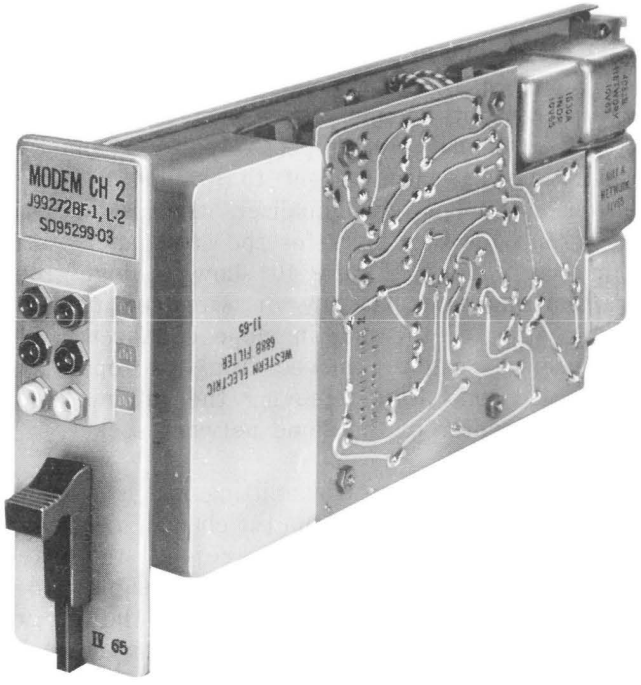


Fig. 7—Message Channel Modem Unit With Crystal Filter—Front View

(b) J99272BA, an Amplas assembly for special services or through-channel message circuit use.

(c) J99272BD, a printed wiring version of the BA unit.

The J99272BA or BD unit may be used without restriction. The voice-frequency amplifier includes separate transmitting and receiving amplifiers. Potentiometers designated IN ADJ and OUT ADJ control the gain of the amplifiers and are accessible on the face of the unit, as are pin jacks which may be used to monitor the voice-frequency input and output of the channel position. This unit may be used in place of any message compandor unit in channel positions C through M when compandor action is not desired.

Fig. 8—Schedules C and D Program Channel Modem Unit

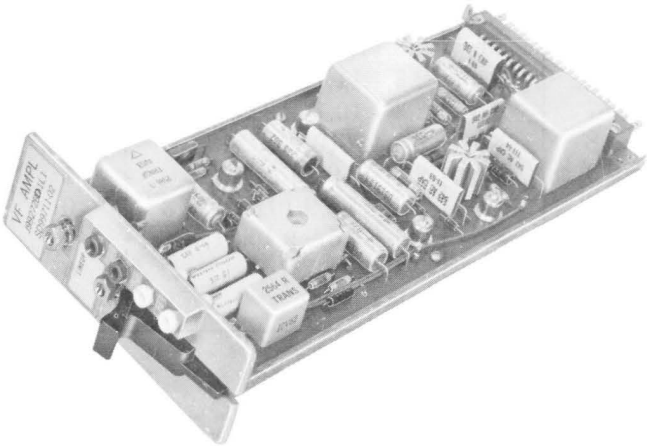


Fig. 9—Voice-Frequency Amplifier

3-Channel Power Load Unit

4.06 The 3-channel power load unit (J99272AE) is a single-module wide plug-in unit containing a resistor to simulate the -21 volt drain of three compandor units and three channel modem units. Power load units are used to build out the load to maintain proper regulation of the -21 volt power supply when an N2 terminal is partially equipped.

Partially Equipped Systems

4.07 The maximum number of message channels may exceed service needs in some special carrier systems and certain compandor and channel modem units may be omitted; however, the number and frequencies of the remaining channels should be chosen to afford adequate regulation of the carrier line repeaters. System regulation, slope, and noise may be degraded on partially equipped systems which are not specifically designed to operate as partially equipped systems. Operation with less than four message or program channels is not recommended. Table B indicates the channel frequencies affording the best regulation in partially equipped systems. Channel 1 may be substituted for channel 2 or 3 if necessary.

TABLE B

CHANNEL ASSIGNMENTS

NO. OF WORKING MESSAGE CHANNELS	N2WM1	MESSAGE CHANNEL NUMBERS	NO. OF 3-CHANNEL POWER LOADS
4	No	2,3,12,13	2
5	No	2,3,11,12,13	2
6	No	2,3,4,11,12,13	2
7	No	2,3,4,10,11,12,13	1
8	No	2,3,4,5,10,11,12,13	1
9	No	2,3,4,5,9,10,11,12,13	1
10	No	2,3,4,5,6,9,10,11,12,13	0
11	No	2,3,4,5,6,8,9,10,11,12,13	0
4	Yes	2,3,12,13	0
5	Yes	2,3,4,12,13	0

5. COMMON PLUG-IN UNITS

Group Units

5.01 The group transmitting and group receiving units are double-module wide plug-in units which provide the amplification, frequency translation, and filtering required in connecting the channel modem units to the line. Low-group transmitting and receiving units include a 304-kHz oscillator and modulator because the channel modem unit transmit and receive high-group frequencies only, whereas line frequencies may be either high-group transmitting and low-group receiving or low-group transmitting and high-group receiving. Through the use of the N2 switching set and paralleled connectors on the line terminating unit, group units may be replaced on an in-service basis. Test points are provided on the face of each group unit to facilitate various trouble location and performance tests. Each group unit includes an internal jack for a plug-in slope equalizer which may be changed as required to match the system terminal to line arrangements or conditions when they are changed. The faceplate of each unit includes the words SLOPE NET with space for a pencil record of the plug-in slope equalizer used. Also, the setting of the small increment built-in slope adjustment for group receiving units may be indicated. This facilitates selection of the proper equalizer and setting for replacement units and units used in the switching set. A similar marking opposite the word USE will indicate wiring options for terminal or switching set use.

5.02 The plug-in slope equalizers are coded 364A, B, C, D, E, F, and G. They provide a group transmitting unit output slope of -9, -6, -3, 0, +3, +6, and +9, respectively, for channel 13 carrier power with respect to channel 2 carrier power. The 364-type equalizers are also used in the group receiver units for the same amounts of slope correction. Figure 10 shows a high-group transmitting unit partially disassembled to show the location of the plug-in slope equalizer. The equalizer is readily removed from the top of the assembled unit after removing the retaining bolt from the center of the slope network socket.

5.03 The high-group transmitting unit is designed to receive signals from the channel modulators at high-group frequencies, reject unwanted frequencies, and amplify the desired signals to a suitable level for transmission over the carrier line. The desired output slope is obtained by inserting the appropriate 364-type equalizer. A wiring option is provided to increase the midband gain approximately 3 dB when the unit is used in a switching set. There are two electrically identical versions of the high-group transmitting unit: J99272G, an Amplas assembly; and J99272BG on printed

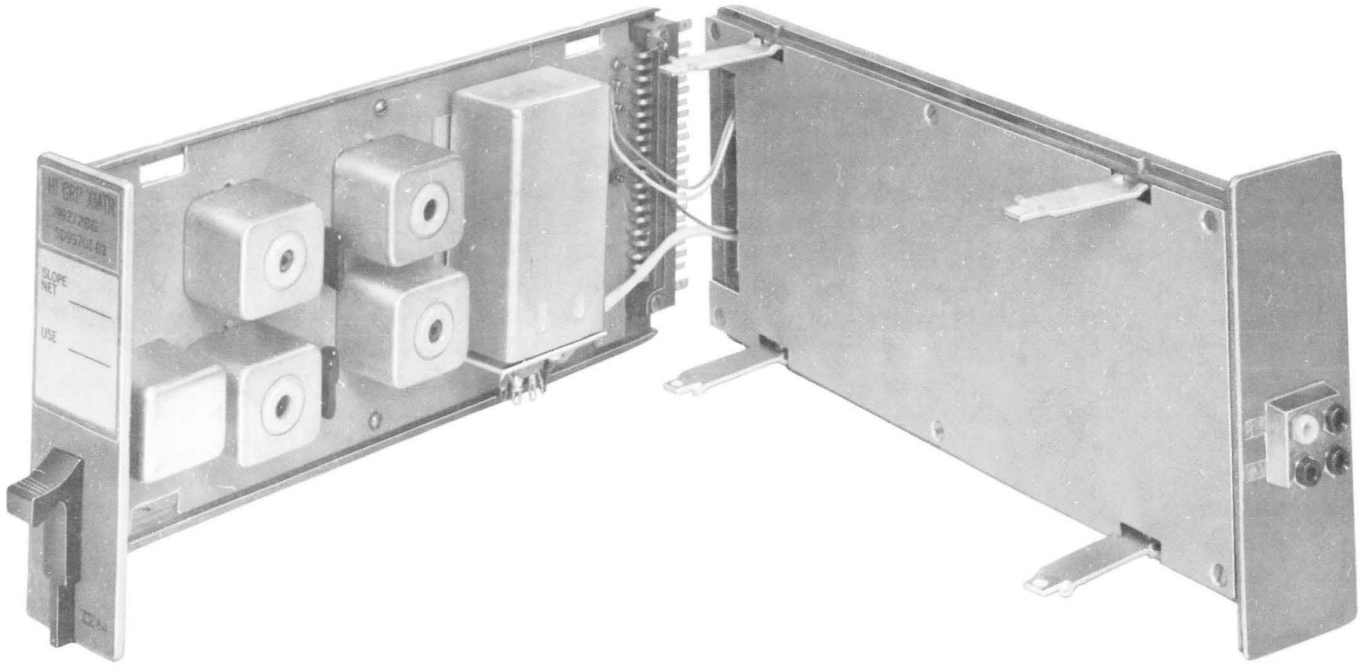


Fig. 10—High-Group Transmitting Unit—Partially Disassembled

wiring boards. Figure 11 shows the J99272BG unit.

5.04 The low-group transmitting unit is designed to accept signals from the channel modulators at high-group frequencies, translate them to low-group frequencies by modulation with a 304-kHz carrier, and then amplify them to a suitable level for transmission over the carrier line. The desired output slope is obtained by inserting the appropriate 364-type equalizer. A wiring option is provided to increase the midband gain approximately 3 dB when this unit is used in a switching set. There are two electrically identical versions of the low-group transmitting unit: J99272H, an Amplas assembly; and J99272BH on printed wiring boards. Figure 12 shows the J99272BH unit.

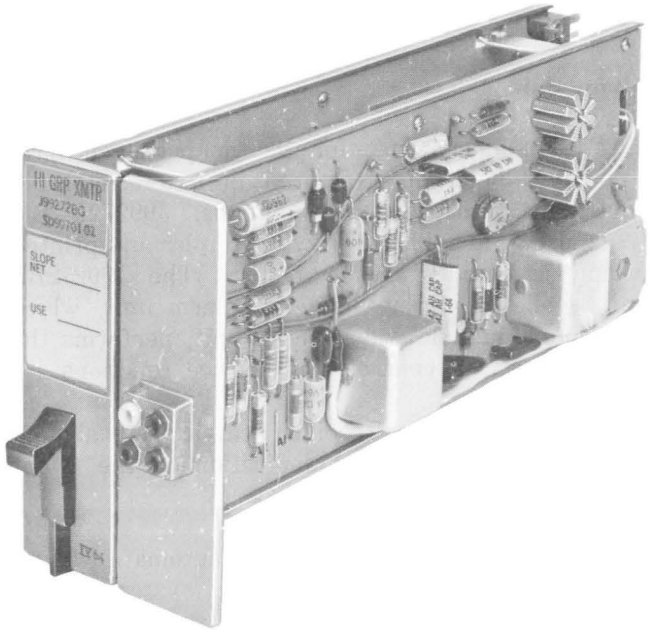


Fig. 11—High-Group Transmitting Unit—Front View

5.05 The high-group receiving unit receives the high-group frequencies from the carrier line, rejects unwanted frequencies, and provides proper slope equalization. A regulating amplifier automatically adjusts the gain to maintain a constant output power of combined carriers. The output of the unit is applied to the 12 channel receiving band filters. Coarse slope correction is provided by inserting the appropriate 364-type equalizer. Finer slope adjustment of +1, 0, or –1 dB (A, B, or C setting, respectively) is built into the unit and controlled by the operation of a switch on the faceplate. Optional wiring permits setting the unit at fixed gain instead of regulating gain when it is used in the switching set and during certain unit tests. There are three versions of the high-group

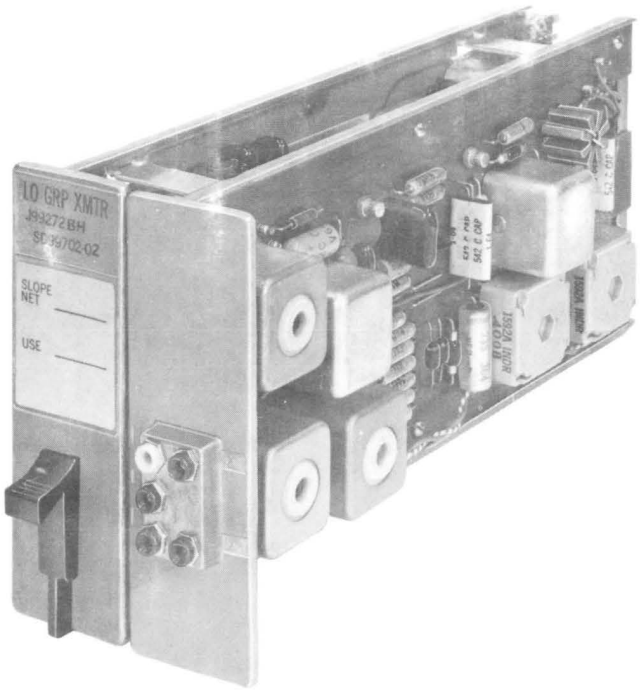


Fig. 12—Low-Group Transmitting Unit—Front View

receiving unit: J99272J, an Amplas assembly designed for use with channel modem units with LC filters; and two electrically equivalent units, J99272AJ and J99272BJ on Amplas and printed wiring boards, respectively. The latter two codes were designed for use with crystal or LC filter channel modem units or a mixture of the two in the same terminal. The J99272BJ unit is shown in Fig. 13.

5.06 The low-group receiving unit receives low-group frequencies from the carrier line, rejects unwanted frequencies, translates from low group to high group by modulation with a 304-kHz carrier provides slope equalization, and includes filtering for suppression of carrier leak and the unwanted group sideband. A regulating amplifier automatically adjusts the gain to maintain a constant output power of combined carriers. The output of the unit is applied to the 12 channel receiving band filters. Coarse slope correction is provided by inserting the appropriate 364-type equalizer. Finer slope adjustment of -1, 0, or +1 dB (A, B, or C setting, respectively) is built into the unit and controlled by operation of a switch on the faceplate. Optional wiring permits setting the unit at fixed gain when it is used in the switching set or during certain unit tests. There are three

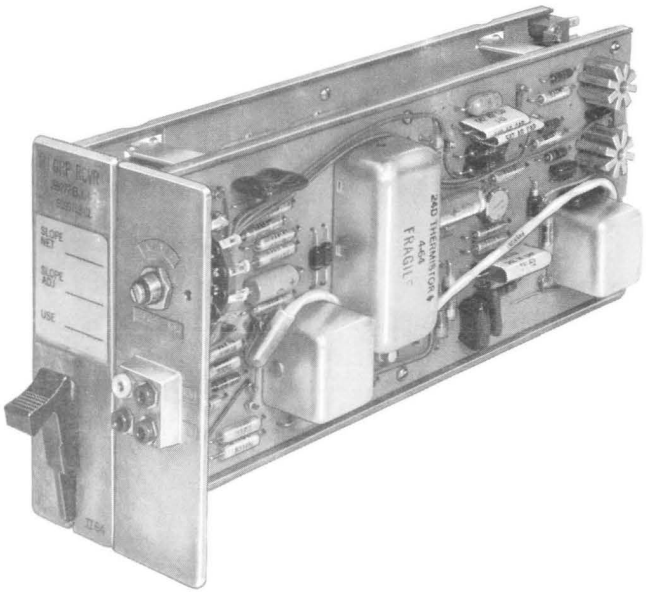


Fig. 13—High-Group Receiving Unit—Front View

versions of the low-group receiving unit: J99272K, an Amplas assembly designed for use with channel modem units with LC filters; and two electrically equivalent units, J99272AK and J99272BK on Amplas and printed wiring boards, respectively. The latter two codes were designed for use with crystal or LC filter channel modem units or a mixture of the two in the same terminal. The J99272BK unit is shown in Fig. 14.

Alarm Unit

5.07 The alarm unit for the nonpackaged bays has been manufactured in two electrically equivalent, interchangeable versions: J99272L (L1, L2, and L3), and J99272BL with Amplas and printed wiring assemblies, respectively. The J99272BL unit is shown in Fig. 15. The alarm unit, which is a double-module wide plug-in unit, performs the following alarm, control, and service functions:

(a) Monitors the received carrier signal and provides an alarm indication in the event of carrier failure.

(b) Initiates and terminates automatic trunk conditioning in the event of system failure through alarm relay operation in association with the external E-type signaling unit, CGA signal receiver, and carrier group alarm equipment.

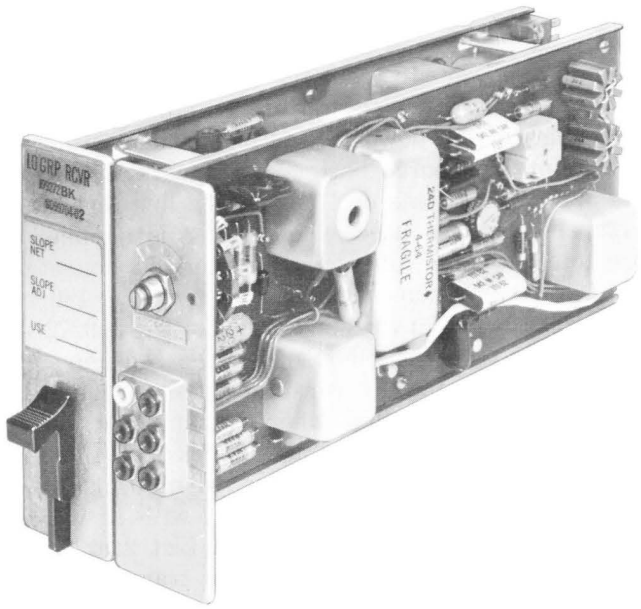


Fig. 14—Low-Group Receiving Unit—Front View

(c) Includes a delay feature which prevents alarm indications from being given for very short duration carrier failures.

(d) Monitors the output of the –21 volt power supply and provides an alarm indication of excessive voltage deviation or failure.

(e) Provides for connection to office alarm systems through common bay alarm relays on the bay cable terminating unit.

(f) Permits office alarm cutoff while retaining the local alarm indications by means of alarm release keys.

(g) Provides, by means of an alarm override key in conjunction with external carrier group alarm equipment, for manual override of an alarm make-busy condition on selected channels so they may be made good by external patching.

(h) Provides for reoperation of the office alarms if alarm release keys are not restored when the alarm condition has been corrected.

(i) Operates through a relay in the line terminating unit to interrupt transmitted carrier for a short time during the trunk conditioning cycle to initiate trunk conditioning at the distant terminal.

(j) Provides a connector through which power may be connected to the N2 switching set for group unit or N2WM-1 unit switching and through which power may be supplied to the terminal from the switching set during power unit switching.

(k) Short-circuits the voice-frequency output of channel position B under control of the CGA circuit during a part of the trunk conditioning cycle.

(l) Originates an ESS first alarm signal when carrier fails (even momentarily), power fails, or an alarm unit is removed from the bay. As discussed in 7.07, this option is used when an N2 terminal operates into switches of a No. 1 ESS office to minimize pulse signaling or switch operation.

Line Terminating Unit

5.08 ▶There are three versions of the line terminating unit: J99272M on Amplas; and J99272BM and J99272BW on printed wiring assemblies. The J99272BW unit is shown in Fig. 16. Each line terminating unit is a double-module wide plug-in unit which connects the carrier-frequency line pairs to the group transmitting and receiving units and provides for various line powering options. It includes sockets for plug-in span pads which provide between 0- and 44-dB attenuation in 2-dB steps in both the transmitting and receiving directions.

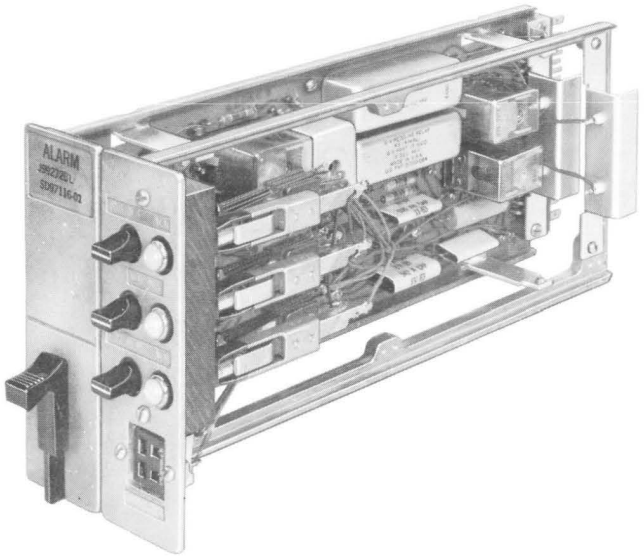


Fig. 15—Alarm Unit—Front View

The J99272M unit uses 38-type pads, and the J99272BM and J99272BW units use 49-type pads. In offices requiring interconnection flexibility, N carrier pairs may be terminated in a high-frequency cross-connecting and line building-out cabinet, a line build-out bay (ED-97031, 32, or 33), or a J99323 line build-out bay with associated line build-out plug-in units. In these cases, span pads and slope networks are provided in the line build-out cabinet or bay, and 38A or 49A (0-dB loss) pads are used in the line terminating unit. The J99323 bay includes provision for supplying power to adjacent repeaters and/or 240-type amplifiers, and for sealing current over the high-frequency line using the simplex of a longitudinal noise control transformer provided for each carrier pair. In all other installations, provision is made for supplying power for repeaters, 240-type amplifiers, and sealing current from the line terminating unit using the simplexes of noise control transformers in the unit. The older J99272M and J99272BM units are electrically equivalent and interchangeable. The J99272BW, List 1 unit for feeding power to remote repeaters includes a constant-current regulator which supplies a constant-current power output independent of normal variations in source battery voltages and extreme temperature effects on transmission line resistance. List 1 units are used when power is supplied to remote electron tube or transistorized repeaters. Power feed options include ±130 volts, +130 and -48 volts, or +130 volts and ground. The J99272BW, List 2 unit (now rated MD) and the replacing List 3 unit do not include constant-current regulators, but must be provided when transmitting sealing current or when terminating simplex leads. A List 2 or List 3 unit must be used when transmitting power to 240-type amplifiers only, with or without sealing current. In addition, the List 2 or List 3 unit is used when power is neither transmitted nor received.◀

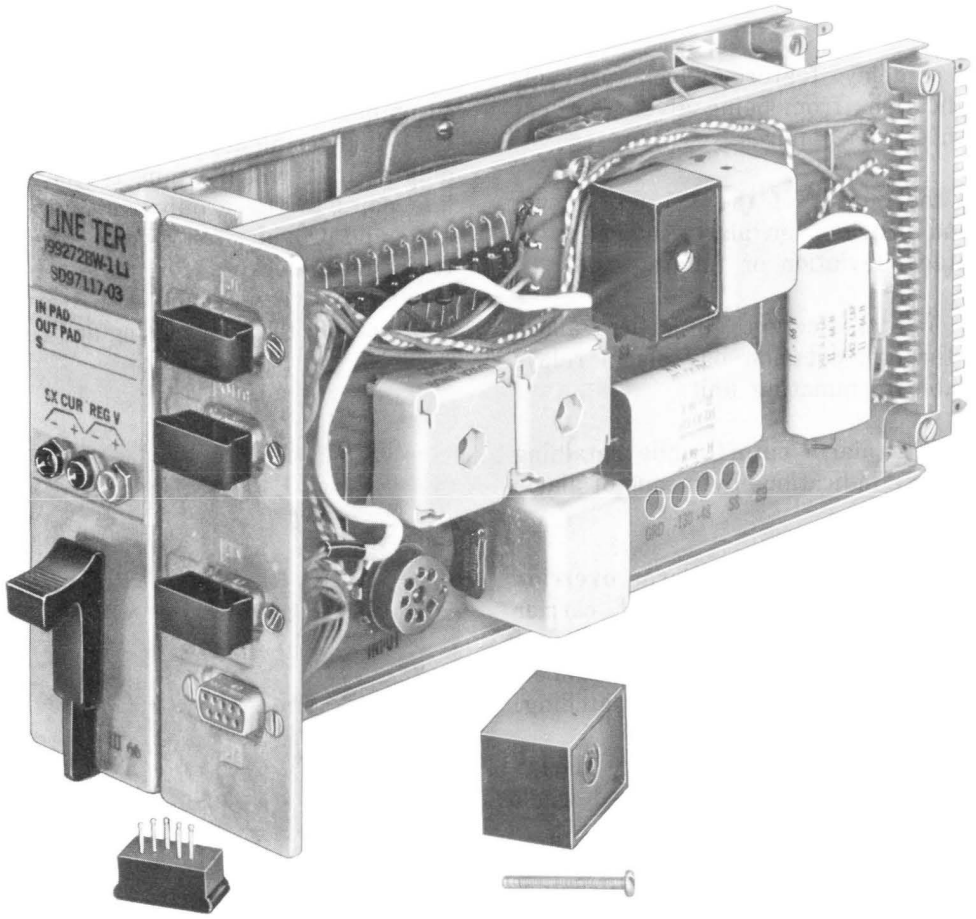


Fig. 16—J99272BW, List 1 Line Terminating Unit—Front View

5.09 ▶Universal wiring and equipment options are provided. Options may be chosen for any condition by operating screw connections, and in the J99272M and J99272BM units by adjusting a single slide wire resistor. Battery feed resistors are distributed between the unit and either the alarm, power, and miscellaneous panel or the bay cable terminating unit in such a manner as to limit the heat to be dissipated in the unit. The unit must be removed from the terminal for changes in span pads, power-feed screw connections or, in the J99272M and J99272BM units, the slide wire resistance setting. Provision is made on the face of the unit for pencil notation of span pad values, screw connections in use and, where used, the resistance of the slide wire resistor.◀

5.10 ▶Voltage surge protection of group unit transistorized circuits is provided by varistors located in the line terminating unit. The unit includes four switching jacks used in conjunction with the N2 switching set for in-service replacement of either group unit. These jacks also provide access for measuring individual and total carrier powers. Pin jacks are provided on the face of the unit for in-service measurement of line current on all units and regulator voltage on the J99272BW, List 1 unit. Included is a relay which disconnects power from the group transmitting unit during a part of the trunk-conditioning cycle.◀

Power Supply Unit

5.11 The -21 volt power supply unit is a dc-to-dc transistorized converter operated from the -48 volt supply to provide a -21 volt regulated supply for the transistorized terminal equipment. One such power supply unit is required for each 12-channel terminal. It is a 4-module wide plug-in unit. There are two versions of the power supply unit, J87216A and J87216C. The J87216C unit, shown in Fig. 17, differs from the earlier J87216A unit in minor component changes. The face of the unit includes an output fuse and a control for manual adjustment of the output voltage.

6. WIDEBAND MODEM UNITS

6.01 ▶The N2WM-1 wideband modem equipment, described in the associated Plant Series sections, may be used to replace the six voice channel modems and compandors located in channel positions G through M in the top shelf of an N2 terminal. In this application, wideband data signals occupy the frequency spectrum allocated to voice channels 5 through 11.◀

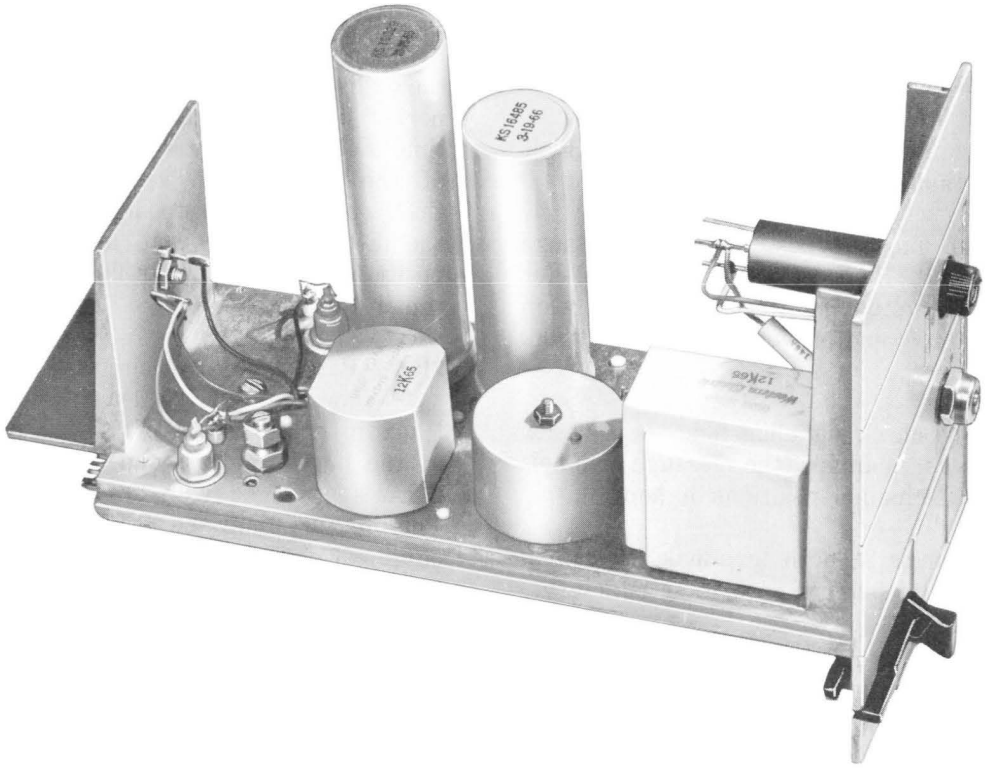


Fig. 17—Power Supply Unit—Front View

7. CARRIER GROUP ALARM

7.01 Standard E-type signaling equipment is required for signaling as well as for the carrier system testing and service restoral purposes discussed in 1.05, 7.02, and 7.12. Standard signaling supply units or bays with cabling to a distributing frame may be used. Each N2 carrier terminal requires from 3 to 13, or possibly 25, signaling unit positions on the supply unit or bay, depending on the signaling and trunk conditioning requirements of the channels derived from the particular N2 carrier system. One of the signaling unit positions is used for the carrier group alarm (CGA) signal receiver. The E-type signaling units in the other positions may be any standard E-type signaling unit as required for the type of signaling desired for the associated message channel. The cabling between the signaling unit positions and the distributing frame may be universal 12-wire, 8-wire for signaling units other than E1F, or 7-wire for E1F as dictated by office or signaling unit requirements. Different lists of the CGA signal receiver must be used to coordinate with 12-wire or with either 7-wire or 8-wire cabling as discussed in 7.12.

7.02 Carrier group alarm and associated carrier terminal circuits are designed to automatically function as follows:

(a) Recognize carrier system failure.

(b) Give alarm and start trunk conditioning at both terminals of the N2 system.

(c) Disconnect most types of busy message trunk circuits and afford an interval for subscriber disconnect of other types, stop subscriber charges, and prevent subsequent trunk seizures.

(d) Monitor and check signaling tone transmission over two test channels (the message channels associated with channel positions A and B).

(e) Restore alarms at both terminals when test channel signal performance is satisfactory.

(f) Return trunks at both terminals to service at the same time.

Items (a) and (b) are controlled by the alarm units in the N2 terminals at the ends of the N2 carrier system. Signals from these alarm units cause the CGA units at the N2 terminals to perform item (c) functions on the message channels having E-type signaling units at the respective terminals. Channels not equipped with E-type signaling at an N2 terminal cannot be conditioned at that terminal because trunk conditioning is accomplished by changes in direct-current supervision on the trunk side of the E-type signaling units. Item (d) is accomplished by the CGA units, the E-type signaling units associated with channel positions A and B at the two terminals, and the CGA signal receivers associated with channel position A. When satisfactory E-type signals (2600 Hz) are obtained in both directions, the two CGA units cause the alarm units to restore alarms, item (e). At both terminals the CGA units simultaneously remove the make-busy conditions and restore to normal the connections between E-type signaling units and trunk circuits.

7.03 During parts of the channel testing procedure, item (d) above, the circuitry of the CGA conditions the E-type signaling units associated with channel positions A and B to transmit 2600-Hz signal tones over the N2 system. Presence or absence of the tone in channel position B at the receiving terminal is determined by the associated E-type signaling unit and conveyed by an E lead to the CGA unit. Presence or absence of the tone at channel position A is determined by a CGA signal receiver and conveyed by its E lead to the CGA unit, which includes a delay circuit to assure the undisturbed presence of tone for a predetermined period before full recognition by the CGA. This time delay and the signal-to-noise characteristics of the CGA signal receiver prevent premature CGA operation due to signals which may operate the E-type signal unit associated with channel position A during carrier line fluctuations following repair of the line.

7.04 Part of the CGA circuitry is used to condition the supervisory leads (including T and R leads in some cases) of associated trunk circuits at the beginning and end of carrier failure. The CGA is arranged with an alarm override feature. This feature may be used on a nontest channel equipped with E-type signal units for E and M lead supervision, or with E1L, E1L-A, E1S, or E1S-A signal units when it is desired to release the trunk conditioning on so-called special service channels which have been patched to another facility while the N2 system is disabled. Suitable option straps permit preassignment of special service channels, but the manual operation and release by an override key must be coordinated with the

external patching of the associated 4-wire carrier channels for all the special service assignments in the N2 carrier system at both system terminals.

7.05 It should be emphasized that the CGA unit, CGA signal receiver, and the E-type signaling units associated with channel positions A and B must always be located in the same office as the N2 carrier terminal. Furthermore, nontest channels requiring trunk conditioning must be equipped with E-type signaling units in the same office as the N2 carrier terminal nearest the trunk circuits requiring trunk conditioning. These requirements result from the intimate association (via numerous ac and dc leads) of CGA, signaling, and trunk circuits and stringent limitations on the gauge and length of conductors as discussed in 7.06. If a message channel associated with channel position A or B terminates in switches in a remote office, an additional signaling unit at the N2 carrier terminal office must be used to transmit supervision to and from the distant office. However, through signaling from a distant office without E-type signal units at the N2 terminal may be used on channel positions C through M, but no trunk conditioning at the distant office is possible under these circumstances and service reaction may be encountered during N2 system failure.

7.06 The location of the CGA units and the gauge of the cables to and from the distributing frame require special attention because the CGA units are located electrically between the E-type signaling units and the trunk circuits or line finders.

> ***Note:*** The gauge and length of conductors between signaling units and trunk circuits or SXS line finders, including connections to and from the carrier group alarm panel and distributing frame, must be engineered to meet the resistance, ground potential, and return loss requirements of the associated switching system.

7.07 No. 1 ESS offices receive an alarm for trunk conditioning. The alarm signal is initiated after the CGA receives a system alarm indication from the alarm unit. For channels assigned to No. 1 ESS trunk equipment, the supervisory leads between the E-type signaling units and the trunk equipment require processing by the CGA to release the trunks and stop subscriber charges. In addition, certain supervisory leads associated with channel positions A and B which participate in the monitoring functions of the CGA are also processed. The CGA operation serves to release calling and called subscriber lines. No. 1 ESS is programmed in such a manner that when the ESS scanner receives the alarm signal from the CGA, trunks associated with the channels of a failed N2 system are processed as follows:

(a) Released trunks are made idle in accordance with standard disconnect procedures.

(b) Trunks are made busy.

(c) Subsequent trunk seizures are prevented.

(d) Charges are stopped on calls in progress.

(e) Calling and called subscriber lines are released.

Carrier Group Alarm Unit

7.08 The carrier group alarm unit (Fig. 18) is a 23-inch unit providing mounting space for three 1-3/4 or 2-inch plates. It includes relays used in conditioning T and R, E, M, S, etc., leads between trunk circuits and the E-type signaling units associated with test channels No. 1 and No. 2 (usually channels 13 and 2 which are mounted in channel positions A and B) as well as for E-type signaling units which may be associated with 10 nontest channels (channel positions C through M). The CGA is designed to work with all standard E-type signaling units as required and with various trunk circuits as listed on SD-97166-01.

7.09 The specific circuit functions performed by the CGA circuit for each message channel differ widely with the E-type signaling unit and trunk circuit assigned to the channel. They also differ widely between channels assigned to test channel No. 1, test channel No. 2, and nontest channels. The same CGA unit is used for all of the circuit options required in performing test circuit functions, and each test and nontest channel of the CGA is wired to the distributing frame with wiring suitable for all conditions. Accordingly, separate terminal blocks are provided on the CGA unit for each test and nontest channel so that appropriate terminals may be strapped on an individual channel basis when signaling units and trunk circuits are assigned or reassigned. This and the use of E-type signaling units wired to a distributing frame facilitate office engineering and minimize cross-connection changes. Only wire-wrapped

connections are used on the side of the CGA terminal blocks where the optional strapping is done. Solder connections are prohibited because a terminal once soldered cannot be wire-wrapped. Option changes on a working CGA are often required because it is impracticable to "turn down" 12 channels because one is reassigned. Soldering of option straps on a working CGA unit would constitute an unnecessary service hazard. Changes in wire-wrapped connections may be made with negligible hazard because the tool is insulated and pliers are not required.

Strapping Templates

7.10 Plastic templates J99272AP, L4 are used on each CGA terminal block to indicate the option strapping required for each channel and type of signaling unit. Optional strappings are shown in Fig. 101 on SD-97166-01. These templates are perforated for location on the CGA terminal block of the desired test or nontest channel after installer wiring has been connected but before the option straps are placed. Each template is designated for the desired test or nontest block, the type of supervision, the associated E-type signal unit, and the associated trunk circuit. The desired straps are indicated by heavy lines and option letters between the terminals which must be strapped. When a new or different type of signal unit or trunk circuit is to be used, existing straps must be removed using an unwrapping tool. The existing template must be removed and the new one installed; then new straps covering the option lines are applied, using a spring actuated or power driven wrapping tool. Visual inspection may be used at any time to determine whether the template, strapping, signaling unit, and trunk circuit are coordinated. The templates for test channel No. 1 and 2 fit a 28-punching terminal block. The smaller templates for nontest channels have a white background and fit 24-punching terminal blocks.

Carrier Group Alarm Signal Receiver

7.11 The carrier group alarm signal receiver (Fig. 19) is a plug-in unit similar to E-type signaling units and is suitable for use in a signaling unit shelf of an E-type signaling bay which is wired to a distributing frame in a bay. For maintenance association of units, it is preferable that the signal alarm receiver be located adjacent to the E-type signaling units associated with the same N2 carrier system, but it may be located elsewhere if necessary. The CGA signal receiver includes: a high-impedance input transformer, transistor amplifier, 2600-Hz bandpass and band rejection filters, rectifiers, combining circuit, and a relay designed to operate at a predetermined ratio of the 2600-Hz energy to the energy at other frequencies. It functions to monitor the voice-frequency output of channel

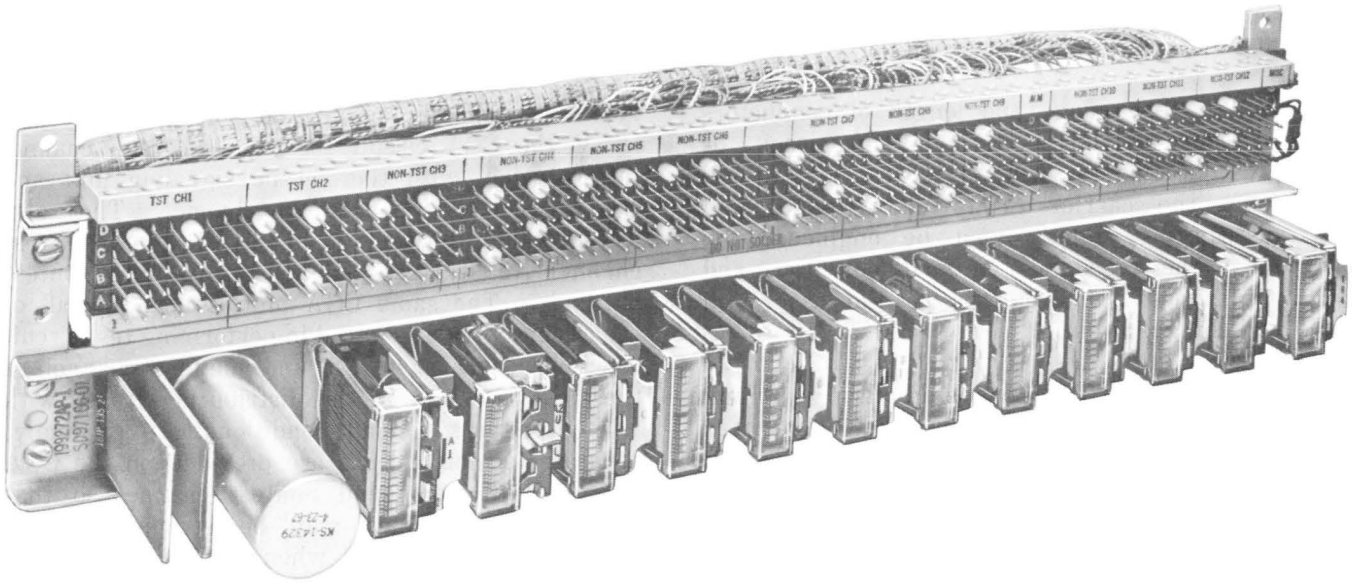


Fig. 18—Carrier Group Alarm Unit—Front View

position A of the N2 carrier terminal during system failure and to signal the CGA unit when the predetermined ratio of 2600-Hz energy to the energy at other frequencies is observed. The CGA signal receiver is designed to ignore high levels of signal and noise due to crosstalk which may be received from an N2 carrier line during system failure and restoration. The CGA signal receiver operates when the N2 carrier system is normal but, unlike many E-type signaling units, does not have to operate in the presence of speech energy. It affects the CGA unit only when the distant end of the channel is transmitting 2600 Hz and speech paths are blocked by CGA operation at the distant terminal.

7.12 The J99272AR, L1 CGA signal receiver unit is used in offices where universal cabling (12-wire) is installed between the E-type signaling units and the distributing frame. It is connected at the distributing frame to the T1 and R1 leads of the associated N2 terminal channel position A and the E-type signaling unit for test channel No. 1. The J99272AR, L2 CGA signal receiver unit is used in offices where 7-wire or 8-wire cabling is installed between the E-type signaling units and the distributing frame (because of E1F signaling units or other reasons). It requires cross-connections at the frame between the T1 and R1 leads of the associated N2 terminal channel position A and the T1 and R1 leads of the CGA, and also between the T and R leads of the CGA and the T1 and R1 leads of the E-type signaling unit assigned to test channel No. 1.

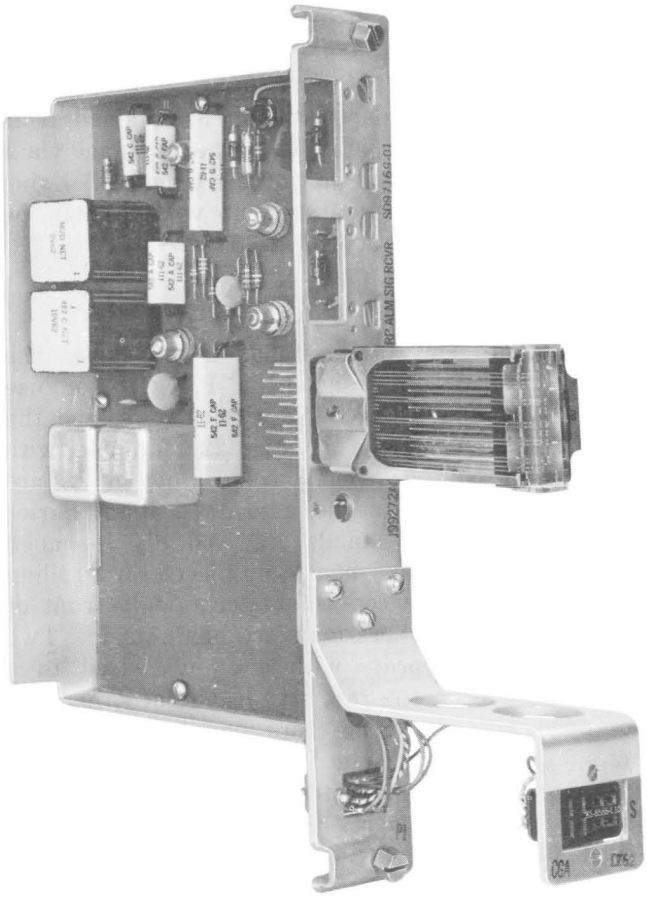


Fig. 19—Carrier Group Alarm Signal Receiver

7.13 The CGA information given in this section applies only when the CGA is associated with N2 carrier equipment mounted on J99272B, D, AS, AL, or AU terminal bays. For a description of the CGA for packaged N2 bays (J99285), see Section 362-801-101.

8. TEST EQUIPMENT

N2 Switching Set

8.01 A portable N2 switching set provides means for substituting an alternate group unit, N2WM-1 transmitting unit, N2WM-1 receiving unit, or power supply unit for the regular working unit without interrupting service. The N2 switching set is shown in Fig. 20. An ammeter, a voltmeter, test jacks, switches, and a gain adjusting potentiometer are mounted on the top face of the set. When used for switching N2 terminal group or N2WM-1 units, the set provides for:

(a) Supplying transmission to the input of an alternate unit without affecting regular transmission.

(b) Monitoring the outputs of regular and alternate units with high-impedance test equipment.

(c) Adjusting the output level of the alternate unit to match that of the regular unit.

(d) Transferring service from regular to alternate unit.

(e) Supplying transmission to the input of a regular unit, for test purposes, after it has been switched from service.

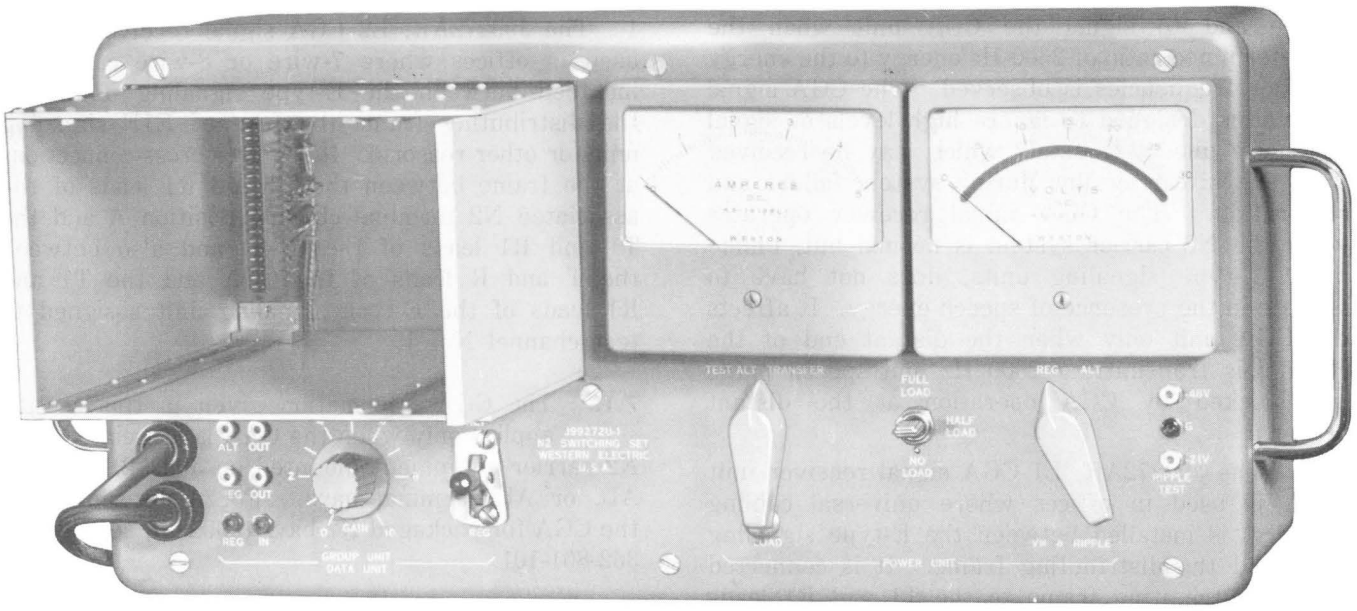


Fig. 20—N2 Switching Set

(f) Measuring the output level of a second unit plugged into the terminal.

(g) Transferring service from the alternate to the second regular unit.

8.02 Power for group or N2WM-1 unit switching is obtained from the regular terminal power supply unit through a connector mounted on the alarm unit. When used for switching N2 terminal power supply units, the set provides for:

(a) Measuring the voltage on both the regular and alternate power supply units.

(b) Measuring the test current load on the alternate power supply unit and the actual current load on the alternate unit during power switching.

(c) Paralleling the –21 volt outputs of the regular and alternate power supply units. This permits transfer of the terminal load from regular to alternate units and vice versa by adjustment of voltage controls on the units while observing the current load of the alternate unit.

Power for power unit switching is obtained from the alarm fuse associated with the terminal via a connector on the alarm unit of the terminal. Using this set, the power unit output voltage may be adjusted to an accuracy of ±0.5 percent.

Terminal Test Stand

8.03 ▶Two terminal test stands are available: the J99272W unit (shown in Fig. 21) for use with J99272 nonpackaged N2 carrier bays, and the J99272AH unit (shown in Fig. 22) for use with the J99285 N2 packaged bays. Both units are described in detail in the associated Plant Series sections. The test stands are basically L-shaped aluminum chassis designed to be placed on a rolling tea wagon at some convenient location in front of the terminal bay where tests are being made. Two 10-foot flexible cords, with one end wired to a terminal strip on the test stand and the other end equipped with plug connectors mounted on die-cast units, provide complete interconnection between the plug-in units under test and the N2 terminal from which they were removed. The two test stands differ primarily in the type of alarm unit tested by each. The J99272AH unit tests only

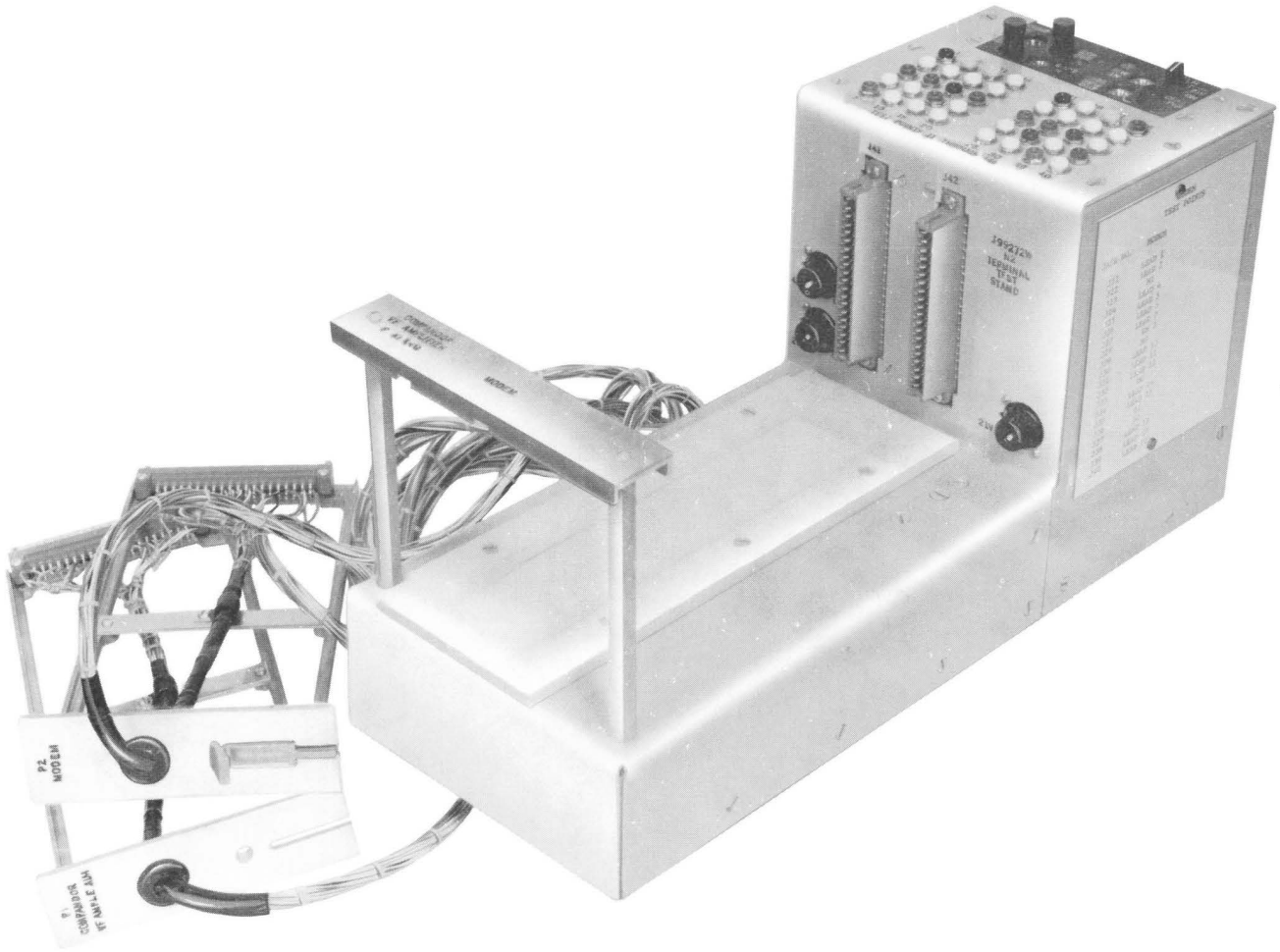


Fig. 21—J99272W Test Stand

the J99272AW alarm and restoral unit used in the N2 packaged bay on an out-of-service basis before insertion into an active terminal. In the N2 nonpackaged bay, the J99272L or BL alarm unit must be tested with the J99272W test stand. Channel components may be tested in either test stand. Means is provided for mounting an alarm unit in the J99272W stand, or channel components in either stand that are removed from but connected to their normal terminal positions in order to facilitate tests and adjustments using normal terminal circuits. Test jacks are provided for monitoring the signal or voltage on each of the connections to the unit under test. The circuit is arranged to permit opening the connections between the N2 terminal wiring and the input to the compressor or transmitting voice-frequency amplifier, or between the output of the expandor or receiving voice-frequency amplifier and the N2 terminal wiring to allow injecting test signals or measuring signal levels on a terminated basis. The J99272AH test stand provides a modem looping test feature which enables the modulation output signal to be looped back to the demodulator input.◀

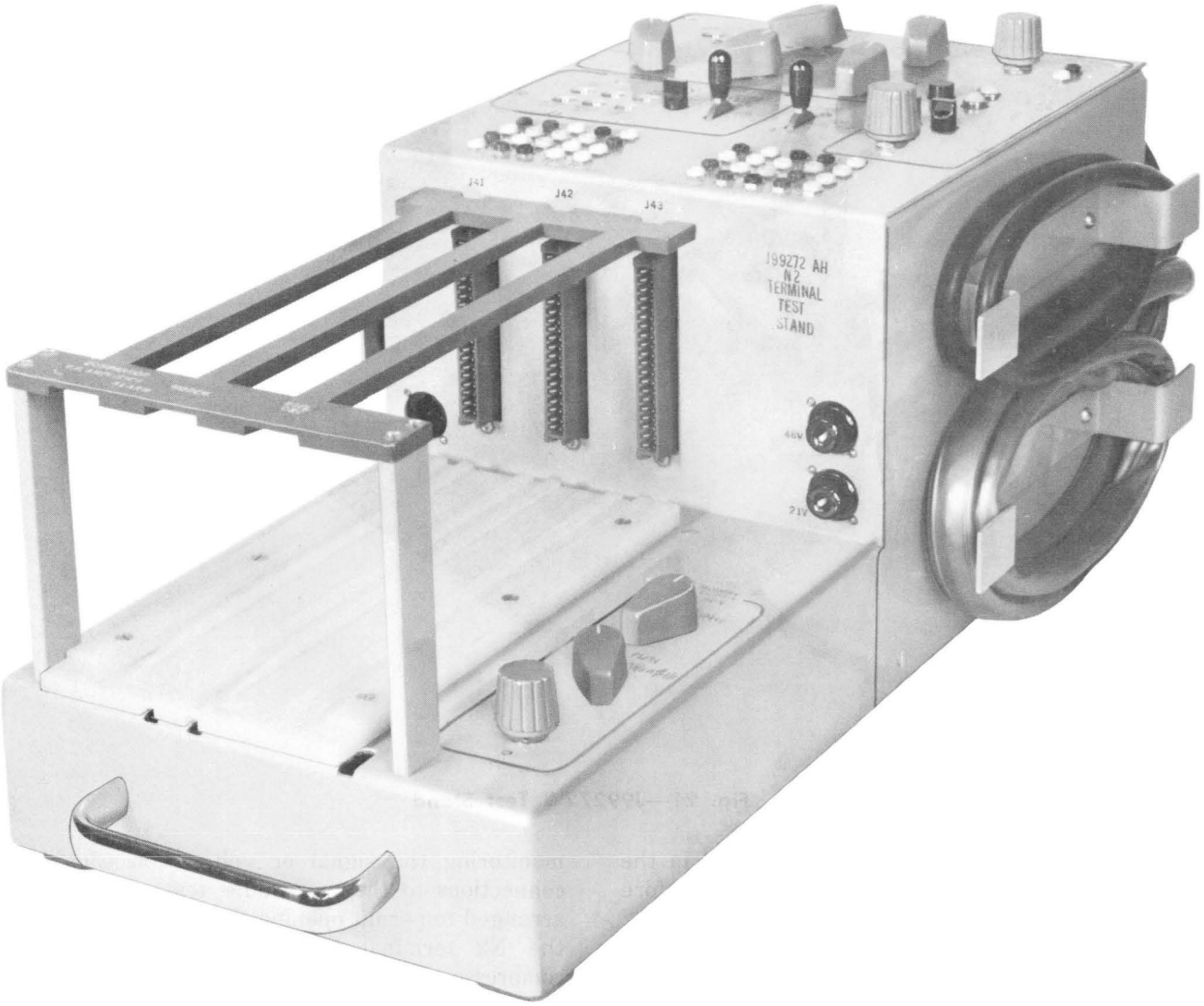


Fig. 22—J99272AH Test Stand

9. DRAWINGS

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

SD-95294-01	Compandor Circuit (J99272E)
SD-95294-03	Compandor Circuit (J99272BE)
SD-95299-01	Channel Modem Circuit (J99272F)
SD-95299-02	Schedule C and D Program Channel Modem Circuit
SD-95299-03	Channel Modem Circuit (J99272BF)
SD-97116-02	Alarm Circuit
SD-97117-03	Line Terminating Circuit
SD-97118-01	Terminal Bay Circuits
SD-97119-01	Miscellaneous Jack and Alarm Panel Circuits
SD-97123-01	N2 Switching Set Circuit
SD-97125-01	Terminal Test Stand (J99272W)
SD-97166-01	Carrier Group Alarm Circuit
SD-97169-01	Carrier Group Alarm Signal Receiver Circuit
SD-97244-01	Alarm and Restoral Circuit
SD-97245-01	Restoral Oscillator Circuit
SD-97253-01	Terminal Test Stand (J99272AH)
SD-97256-01	Alarm Link Circuit
SD-97401-01	Through Channel Connector and Pad Circuit
SD-99701-02	High-Group Transmitting Circuit
SD-99702-02	Low-Group Transmitting Circuit
SD-99703-02	High-Group Receiving Circuit
SD-99704-02	Low-Group Receiving Circuit
SD-99711-03	Voice-Frequency Amplifier Circuit
SD-99712-01	N2WM-1 Wideband Modem Loop Terminating and High-Frequency Equalizer Circuits
SD-99727-01	N2WM-1 Wideband Modem Transmitting Circuit
SD-99728-01	N2WM-1 Wideband Modem Receiving Circuit
J87216	21-Volt Power Supply
J98613	E-Type Signaling
J99272	N2 Nonpackaged Bay Equipment
J99323	N2 Line Build-Out and Cross-Connection Equipment◀