SECTION 362-915-101
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AT&TCo Standard

TYPE N3 CARRIER TELEPHONE SYSTEM
PLUG-IN SECONDARY CARRIER DISTRIBUTION CIRCUIT
DESCRIPTION

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1. GENERAL

1.01 This section describes a plug-in version of the secondary carrier distribution circuit which provides the means of coupling the N3 common carrier supply to N3 terminals or Type B or C N3-L Junctions (see Fig. 1).

1.02 The secondary distribution circuit provides the required carrier frequencies at the correct power level for modulation, demodulation, and carrier line regulation in two N3 terminals or two Type B or C N3-L Junctions. The circuit processes and distributes 16 carrier frequencies obtained from an N3 common carrier supply. The carrier-frequency power consists of single frequency voltages having a high degree of purity. The level and frequency characteristics of these carriers are precisely controlled.

1.03 Distribution amplifiers are used for all carrier frequencies, thereby permitting high attenuation in the output circuit pads and a high degree of isolation between output taps. The use of active elements provides isolation between the input circuit and the output taps. The input impedance presented to the common carrier supply remains constant with variations in the secondary distribution circuit output load terminations. Regulating amplifiers are used only to process the even-numbered channel carriers for transmission over the high-frequency line.

1.04 Thin film resistors, used in the voltage divider and distribution circuits, will provide long-term stability of carrier frequency power output levels because of initial close tolerances and the expected small deviations in resistance values over the life of the circuit.

1.05 Convenient access to the distribution circuitry is provided by the use of plug-in assemblies, and all tests and adjustments are made from the front of the bay.

2. EQUIPMENT FEATURES

A. Bay Arrangements

2.01 The secondary carrier distribution circuit consists of nine single-module distribution amplifier plug-in units mounted on an ED-3C172-30 secondary distribution shelf. The shelf with plug-in units inserted is illustrated in Fig. 1. One secondary distribution circuit is provided in each 11-foot 6-inch universal packaged frame which has a capacity for two 24-channel N3 terminals or two Type B or C N3-L Junctions. One secondary distribution circuit provides the required carriers for two smaller 9-foot or 7-foot packaged frames, where each has a capacity for only one 24-channel terminal or junction.

2.02 The secondary carrier distribution circuit mounting shelf requires 10 inches of space near the top of the terminal or junction bay in an N3 packaged frame. The shelf is equipped with two 21-pin connectors for each plug-in unit position,

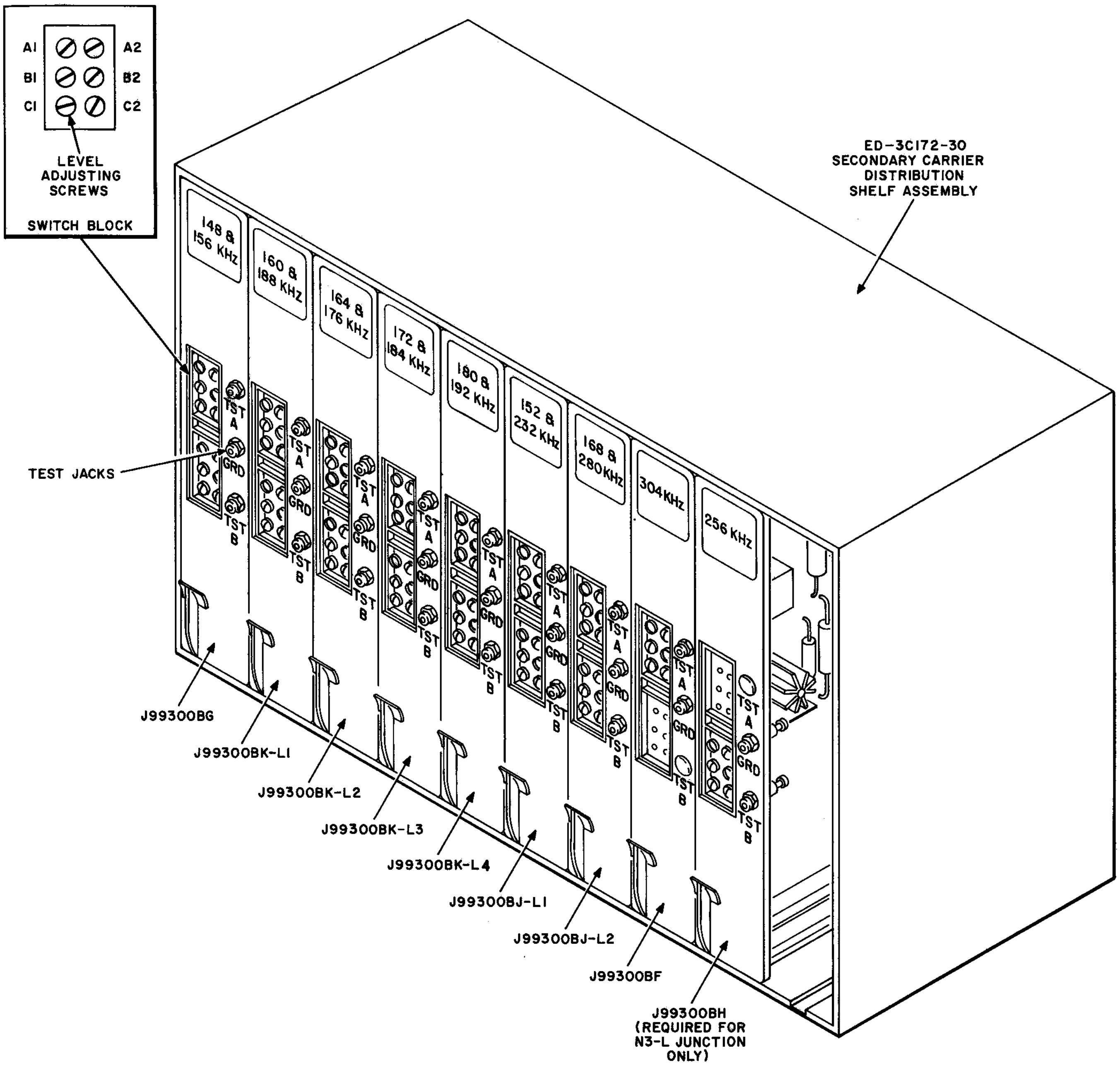

Fig. 1—ED-3C172-30 Secondary Carrier Distribution Shelf and Associated Plug-In Units

through which the carriers from the N3 common carrier supply are connected via ABAM-26 cable (700-foot maximum length) to the distribution and regulating amplifiers. After processing, the carriers are then distributed to the modulators, demodulators, and combining network.

B. Distribution Amplifier Units

2.03 The distribution amplifier plug-in units each contain a printed circuit board fastened to a die-cast aluminum frame. The circuit board contains the components for processing one or two of the required carrier frequencies. All external connections are made through two 21-pin plugs at the back of the unit. Six-position screw-type switch blocks are provided on the face of the unit to permit adjustments of each distribution amplifier input to compensate for the loss of the cable pairs from the primary carrier supply.

2.04 Two of the distribution circuit plug-in units process single unregulated carrier frequencies. One of these nonregulating units processes the 256-kHz carrier used only in the N3-L Junction and may be omitted when Type B or C Junction use is not anticipated. Where this unit is not required, the common carrier supply must be properly terminated by leaving the 115-ohm dummy load resistor in place on the unused 256-kHz output terminals. The other nonregulating single-frequency plug-in unit, shown in Fig. 2, processes only the 304-kHz carrier for use in the transmitting or receiving group modems. The remaining seven units contain two distribution amplifiers each to process the carriers for channel modems and channel group modems. One of these units processes two nonregulated carriers. In each of the other six units, a regulated carrier is combined with a nonregulated carrier on the same circuit board. In addition to the two distribution amplifiers, a regulator circuit is incorporated to provide a regulated carrier for transmission over the high-frequency line. Figure 3 shows a distribution amplifier unit containing distribution circuits for regulated and nonregulated outputs.

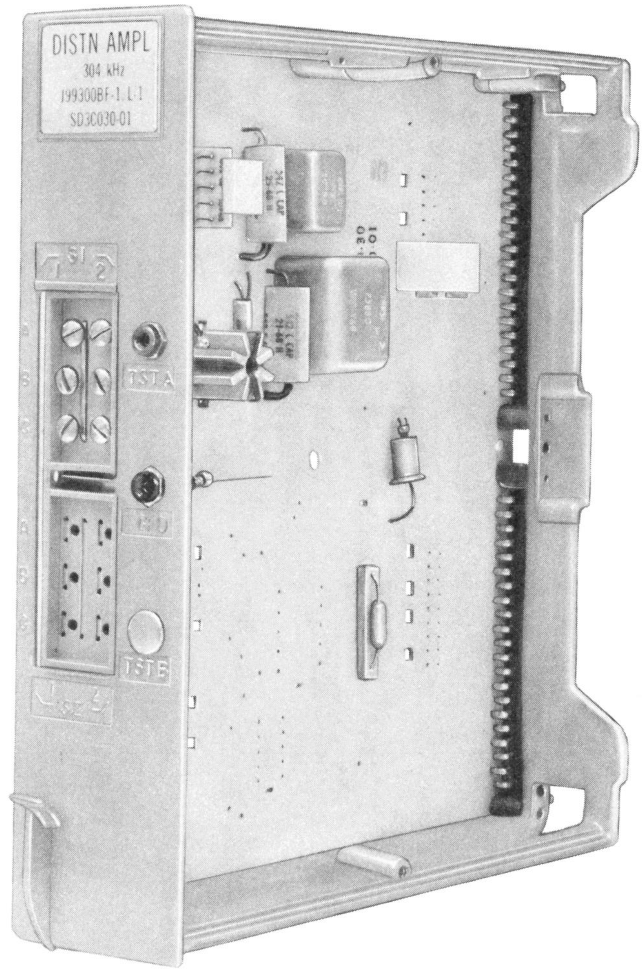

Fig. 2—J99300BF (304 kHz) Distribution Amplifier Unit Containing One Distribution Circuit With No Regulation

3. CIRCUIT DESCRIPTION

A. Distribution Amplifier Units

3.01 The various circuits required in the distribution amplifier units having only nonregulated outputs are shown in simplified form in Fig. 4, and in units having regulated outputs in Fig. 5.

3.02 The voltage divider and emitter-follower circuitry shown in Fig. 6 is identical for each carrier frequency processed by the distribution and regulating distribution circuits. The emitter-follower circuitry supplies the required power to the output pad circuit for distribution to the N3 terminal or Type B or C Junction equipment.

3.03 The distribution amplifier uses two transistors in a Darlington emitter-follower configuration, providing a high degree of isolation between the input and output circuitry. The two transistors in cascade produce a high input impedance to the input transistor, resulting in a negligible shunting effect on the input voltage divider network.

3.04 The input transformer T1 has an impedance ratio of 135:12,500 ohms. Terminated in the voltage divider network, the transformer provides a 115-ohm termination to a pair of leads from the common carrier supply.

3.05 The voltage divider network CP1 is made up entirely of thin film resistors. Nine resistors are used, seven of which provide six tap settings for adjusting the carrier frequency voltage applied to the input transistor. The remaining

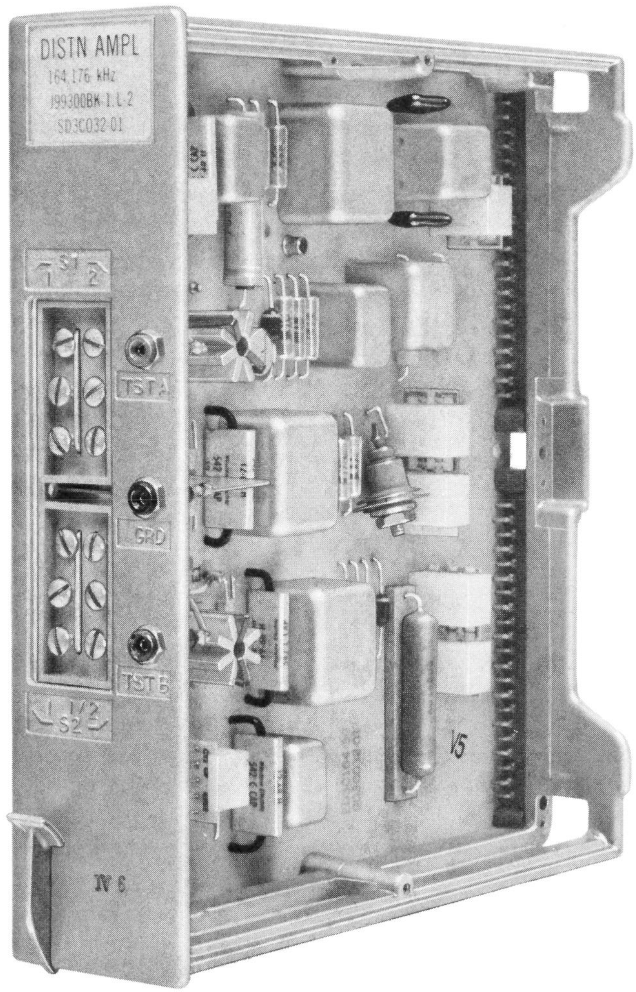

Fig. 3—J99300BK, L2 (164 and 176 kHz) Distribution Amplifier Unit Containing Distribution Circuits For Nonregulated and Regulated Outputs

two resistors are connected as a voltage divider between the 22-volt power supply and ground to provide bias for the input transistor. The current through these two resistors is in excess of the base current of the input transistor, making the base voltage insensitive to variations in base current. A capacitor bypasses the carrier frequency around the biasing network.

3.06 The voltage for the input transistor is taken from the voltage divider network through a 6-tap switch S1. The six tap settings available compensate for an extreme of 2.5 dB in variations of input power and allow adjustment to within 0.25 dB of the desired amplifier output power. Switch setting A1 provides maximum input voltage for use when the input level is low. Other settings provide lower output power with steps of approximately 0.5 dB available for switch settings in the following sequence: B1, C1, A2, B2, C2. Minimum input voltage is provided by switch setting C2 to provide the required output power when the input level is on the high side of the normal range.

3.07 The correct collector current for the emitter-follower transistors is determined by a resistor in the primary circuit of the output transformer. The output signal is bypassed around the resistor by a capacitor. The Darlington circuit configuration provides a low impedance (30 ohms) at the emitter of the output transistor. The voltage at this point may be measured at the TST jack and is used as a reference in adjusting the input voltage by selecting the tap setting of the switch to provide the desired output power level.

3.08 The output transformer T2 provides the transformation from the unbalanced amplifier circuit to a balanced circuit for connection to the output pad. The impedance ratio for this transformer is 575:135 ohms. The transformer presents an impedance of 575 ohms to the output transistor. This provides the optimum load impedance to produce low distortion content in the output waveform.

3.09 In addition to the emitter-follower circuitry, each distribution amplifier circuit includes an output pad. The output pad circuits are entirely made up of thin film resistors forming parallel connected L pads which transform the low impedance at the secondary winding of the output transformer to the impedance required at each load position. The loss of the pad provides the correct power level at each load termination. The pad circuit shown in Fig. 7 provides two output taps with 115-ohms impedance for connection to group modem circuits. The output level for each tap is +6.5 dBm. All other output taps have 135-ohms impedance. The circuit shown in Fig. 8 provides eight output taps at -6.0 dBm for channel modems and N3-L Junction group modems. Figure 9 shows the circuit used to provide two output taps for channel group modems at +3.0 dBm.

3.10 Six of the carrier frequencies are also processed through regulating circuitry. The regulating amplifier is fed through a matching pad which forms one output of the associated distribution amplifier output pad circuit. The circuit shown in

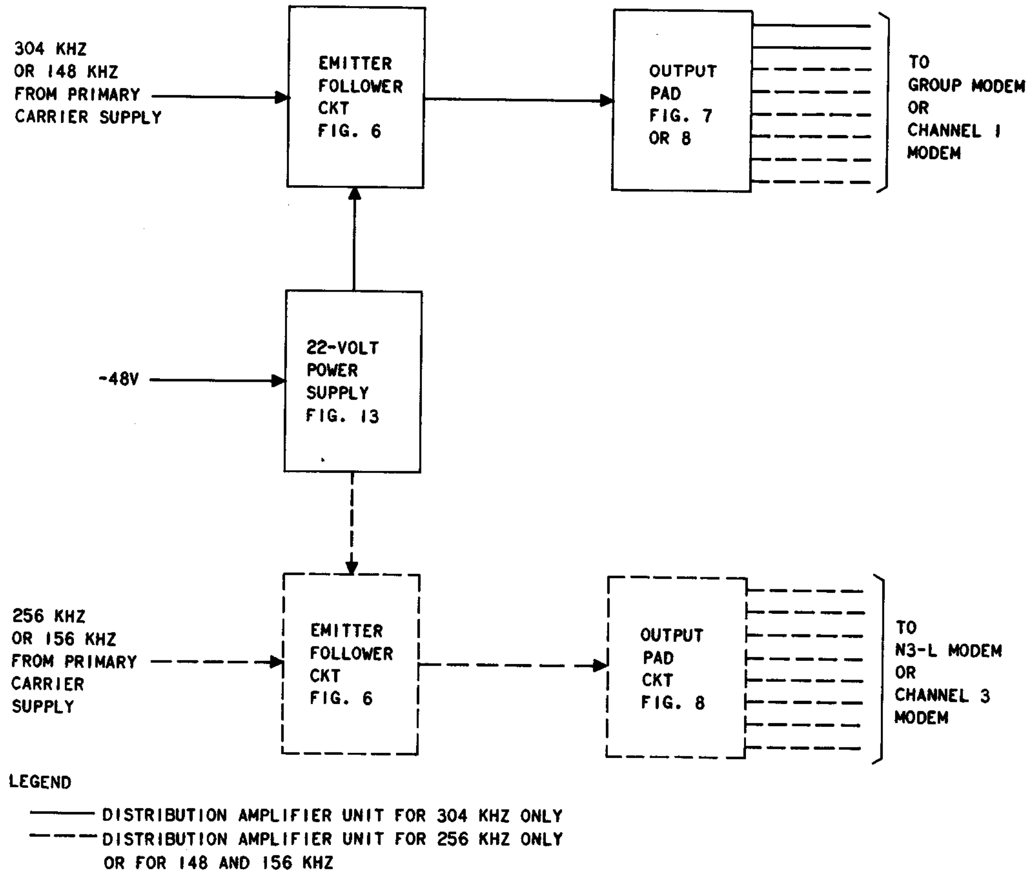

Fig. 4—Nonregulating Distribution Amplifier Units—Block Schematic

Fig. 10 provides four output taps at -6.0 dBm for channel modems and one matching pad for a regulating amplifier. The circuit shown in Fig. 11 provides six output taps at -6.0 dBm for channel modems and frequency-correction units and one matching pad for a regulating amplifier.

3.11 The regulating amplifier circuit, shown in Fig. 12, provides close regulation for the carriers which are transmitted over the high-frequency line. An almost constant output power level is maintained with variations in input power level by a limiting action in regulating circuit transistors.

3.12 During manufacture, capacitor C5 and inductor L1 are tuned to the carrier frequency being processed, and reject all other frequencies. This prevents harmonics which are produced in the regulating amplifier from being propagated back into the distribution amplifier output pad circuit.

3.13 The regulator input transformer T5 has an impedance ratio of 600 to 135 ohms to match the impedance of the matching pad circuit and the input impedance of transistors Q5 and Q6. The transformer has two secondary windings which are terminated in resistors R5 and R6. Voltages in phase opposition are introduced at the bases of transistors Q5 and Q6. The voltage drop across varistor RV1 provides forward bias for the base-to-emitter junctions of the transistors, reducing the amplitude required in the input signal to start conduction in the transistors. Transistors Q5 and Q6 are alternately in either the full conduction or the nonconduction state. The transistor in full conduction has a very small collector-to-emitter voltage and the collector current is at a maximum. At the same time the other transistor is in a state of nonconduction, and the full inverse voltage is present between the collector and the emitter. An alternating current is produced in the primary

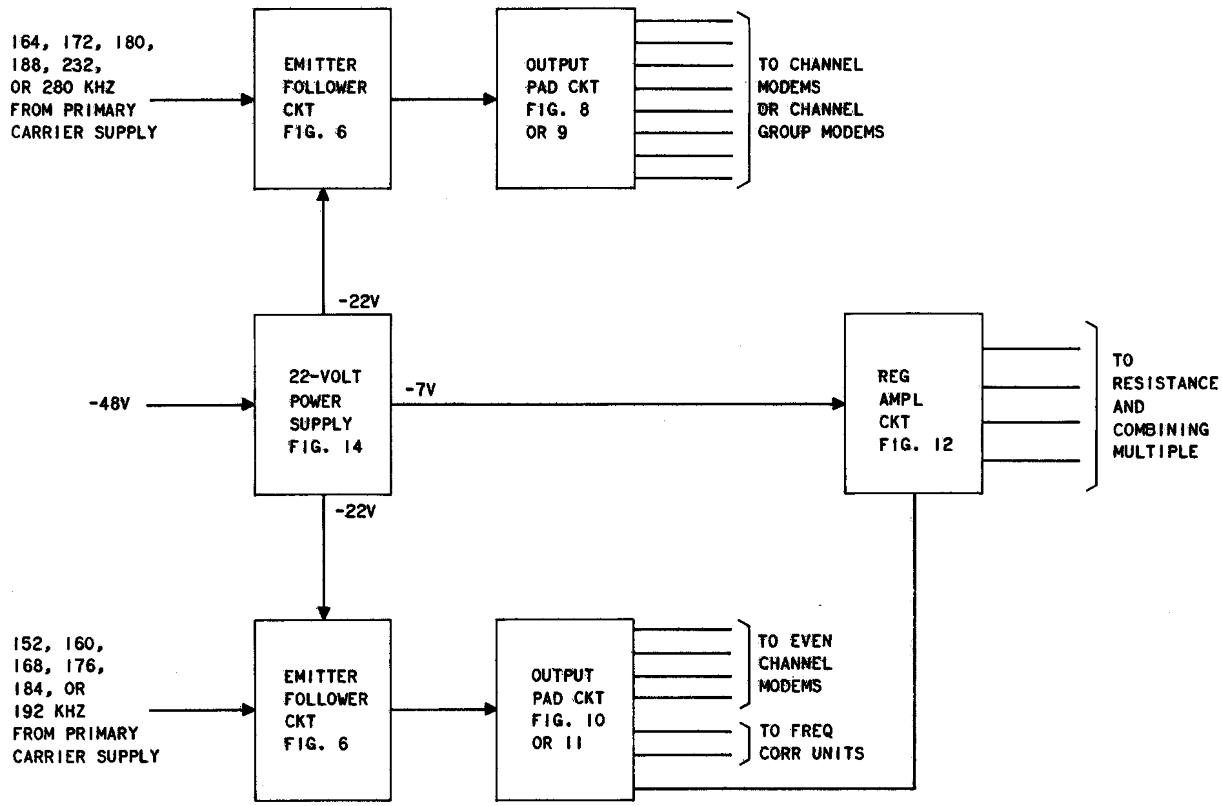

Fig. 5—Regulating Distribution Amplifier Units—Block Schematic

winding of output transformer T6 as the transistors switch alternately from one state to the other. Resistors R8 and R9 provide a small amount of emitter bias and also provide some degenerative feedback. Resistor R4 permits adjustment of the voltage at the junction of resistors R8 and R9. The voltage at this junction determines the amplitude of the output waveform and is adjusted in the process of manufacturing the unit.

3.14 A constant amplitude square wave is developed across the secondary winding of transformer T6. Resistors R10 and R11 match the impedance of the transformer to the impedance of the output filter circuit. The filter circuit is composed of capacitors C7, C8, C9, C10, and inductor L2, and is tuned to pass only the carrier frequency. A sinusoidal waveform is produced across the input terminals of output pad circuit CP6. Pad circuit CP6 is composed of thin film resistors and provides the necessary loss and impedance transformation to supply a carrier power level of −19.0 ±0.05 dBm with 135 ohms impedance for each output load connection.

B. Power Supply

3.15 The power supply circuit provided for the nonregulated distribution amplifier circuits is shown in Fig. 13. The −48 volt office supply is connected to resistor R1 which limits the amount of current permitted to flow in reference diode CR1. Diode CR1 operates in the reverse voltage breakdown region with sufficient current to maintain a constant −22 volt reference voltage with office battery voltage variations between −40 and −56 volts.

3.16 The power supply circuit provided for nonregulated and regulated distribution amplifier circuits on the same board is shown in Fig. 14. In addition to the components used in the power supply for the nonregulated distribution amplifier circuits, resistors R12 and R13, and varistors RV2 through RV6 provide closer regulation

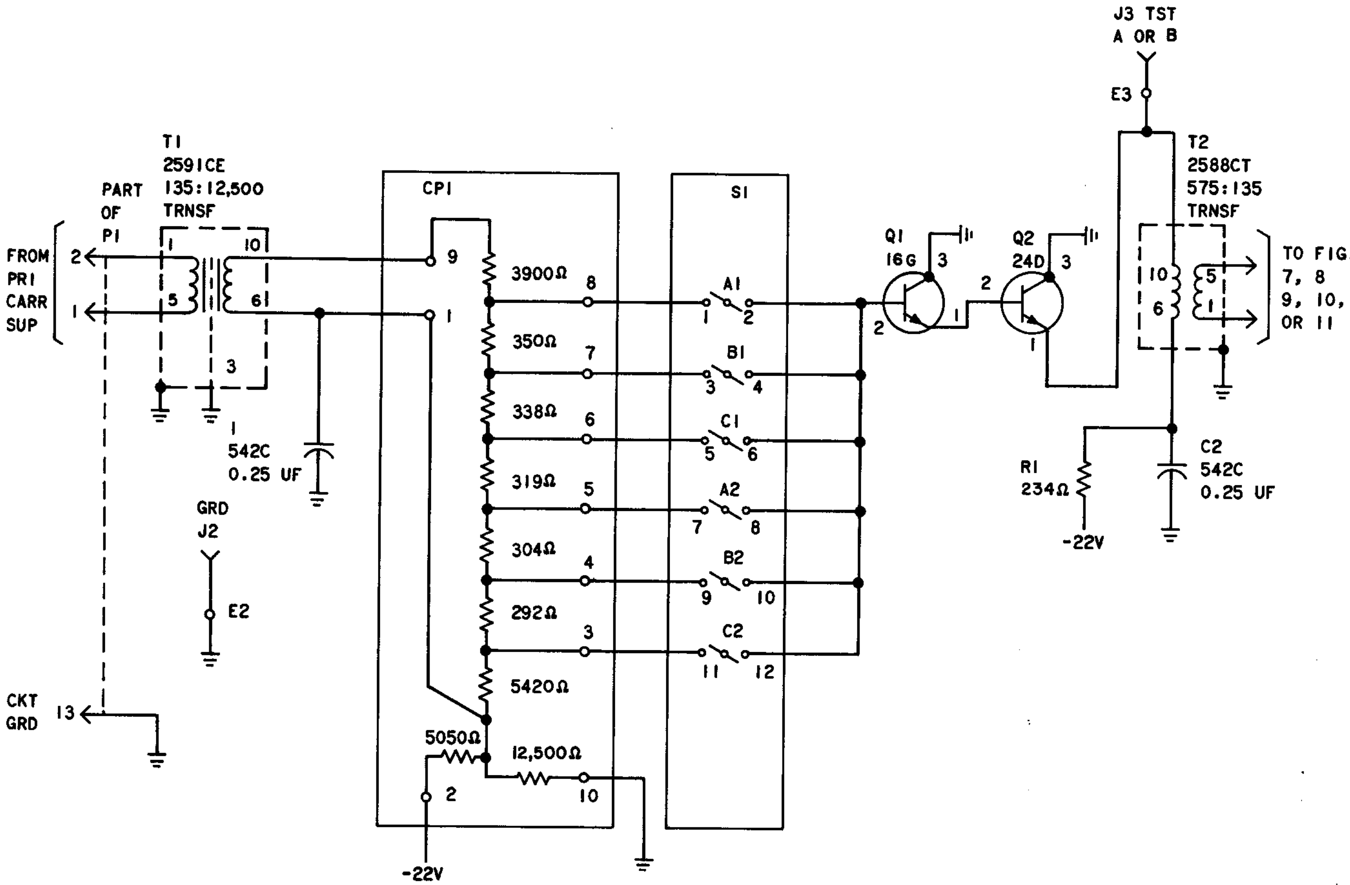

Fig. 6—Distribution Amplifier Circuit

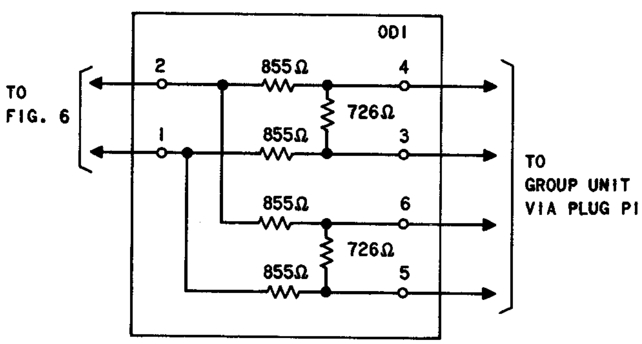

Fig. 7—Output Pad Circuit—Group Modem Output Taps

for the voltages used in the regulating amplifier. A variation in the reference voltage at the junction of diode CR1 and resistor R12 will effect a lesser variation in voltage at the junction of resistors R12 and R13. Varistors RV2 through RV6 have a temperature coefficient which acts in opposition to the change in reference voltage produced by temperature effects on diode CR1. The voltage at the junction of resistors R12 and R13 is unaffected by changes in temperature.

4. TEST AND MAINTENANCE FEATURES

4.01 All transmission level measuring points are located on the front of the distribution circuit plug-in units. All testing is done on a transmission level basis by making unbalanced bridging measurements at test jacks TST A, TST B, and GRD. The test A and B jacks are connected to low impedance points in the distribution amplifier circuits. The test A jack is associated with the distribution amplifier located in the upper half of the plug-in unit, and the test B jack is associated with the amplifier located in the lower half of the unit.

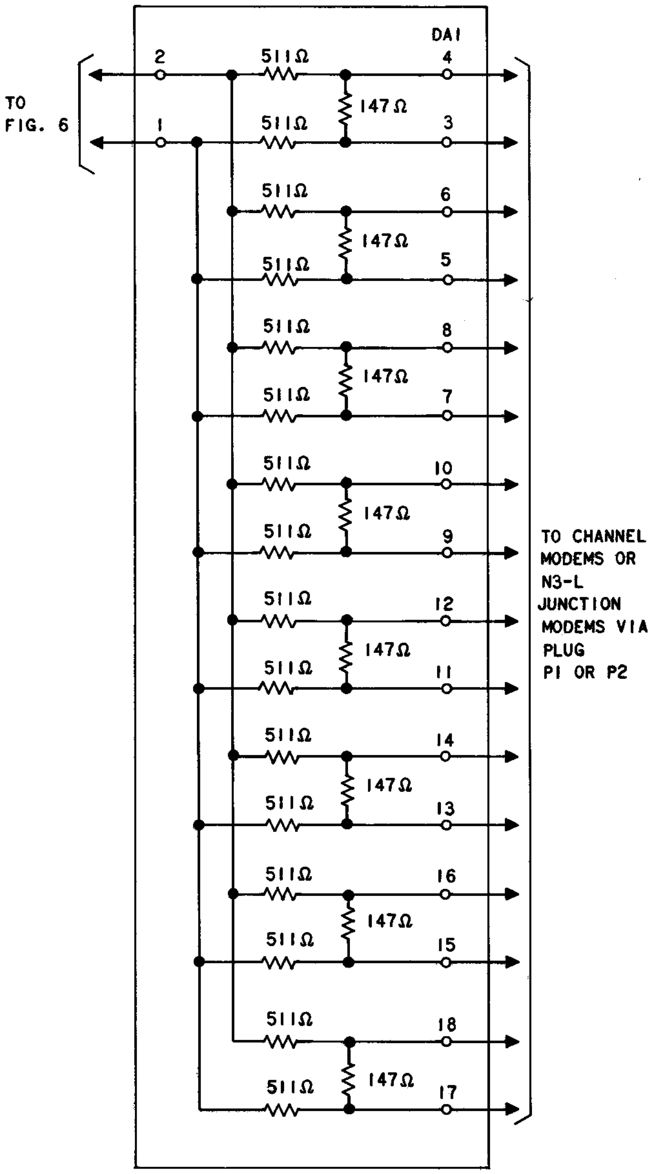

Fig. 8—Output Pad Circuit—Odd-Numbered Channel Modems or N3-L and L-N3 Modulators

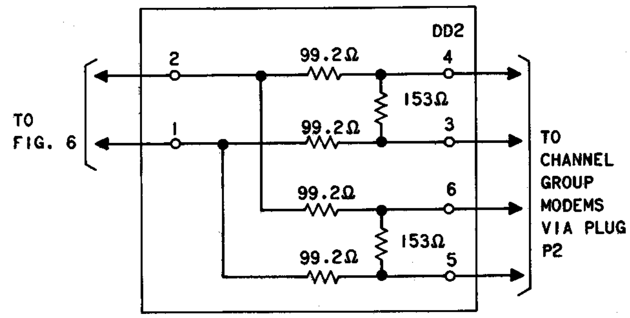

Fig. 9—Distribution Amplifier Output Pad Circuit—Output Taps For Channel Group Modems

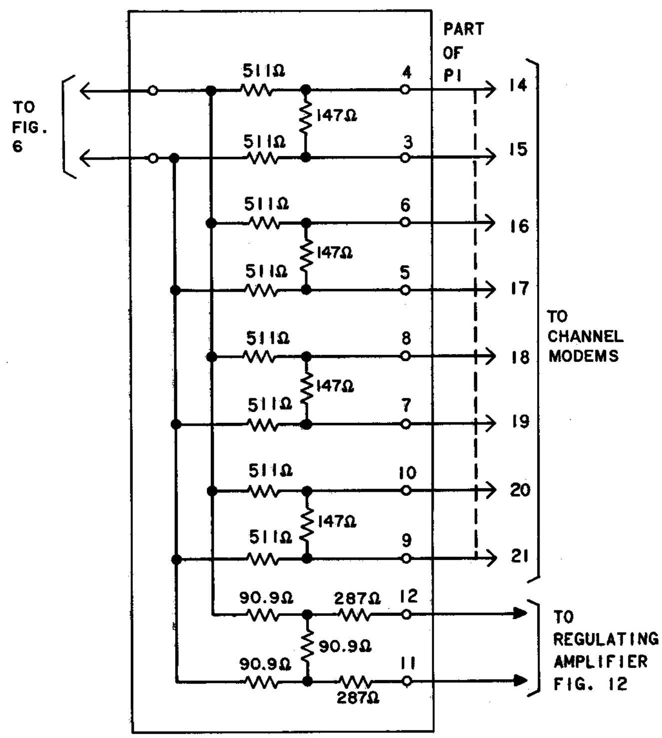

Fig. 10—Distribution Amplifier Output Pad Circuit—Output Taps For Transmitting Channel Modems

5. DRAWINGS (NOT ATTACHED)

5.01 The following drawings give additional information:

SD-3C029-01 J99300BJ Regulating Distribution Amplifier Unit for 232 and 152 kHz or 280 and 168 kHz.

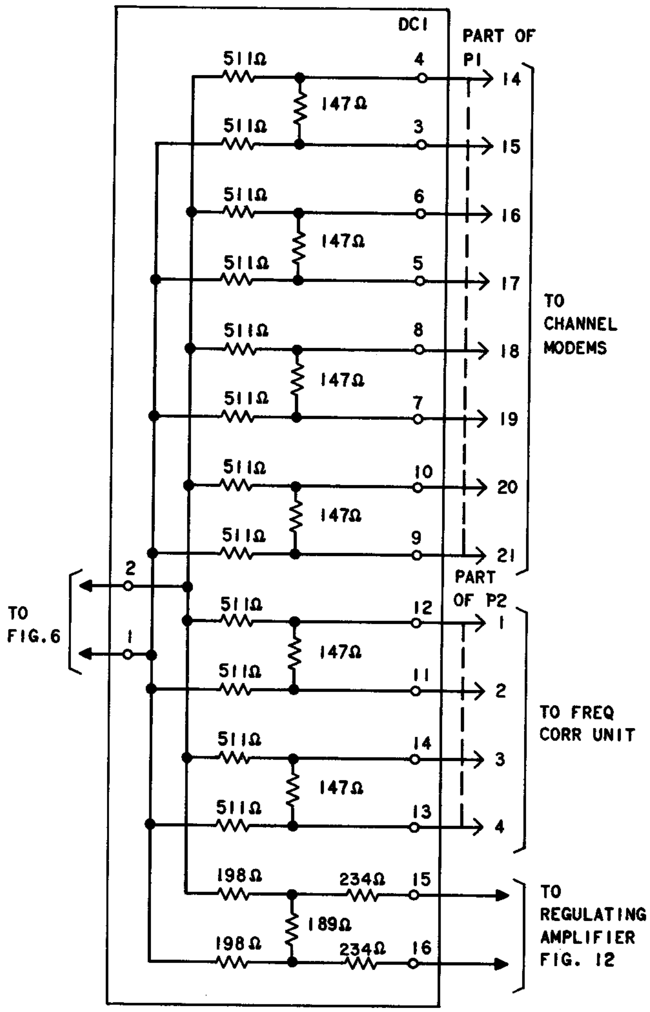

Fig. 11—Distribution Amplifier Output Pad Circuit—Output Taps For Transmitting Channel Modems and Frequency Correction Units

SD-3C030-01	J99300BF Distribution Amplifier Unit for 304 kHz.
SD-3C031-01	J99300BG Distribution Amplifier Unit for 148 and 156 kHz.
SD-3C032-01	J99300BK Regulating Distribution Amplifier Unit for 188 and 160 kHz, 180 and 192 kHz, 172 and 184 kHz, or 164 and 176 kHz.
SD-3C033-01	J99300BH Distribution Amplifier Unit for 256 kHz.

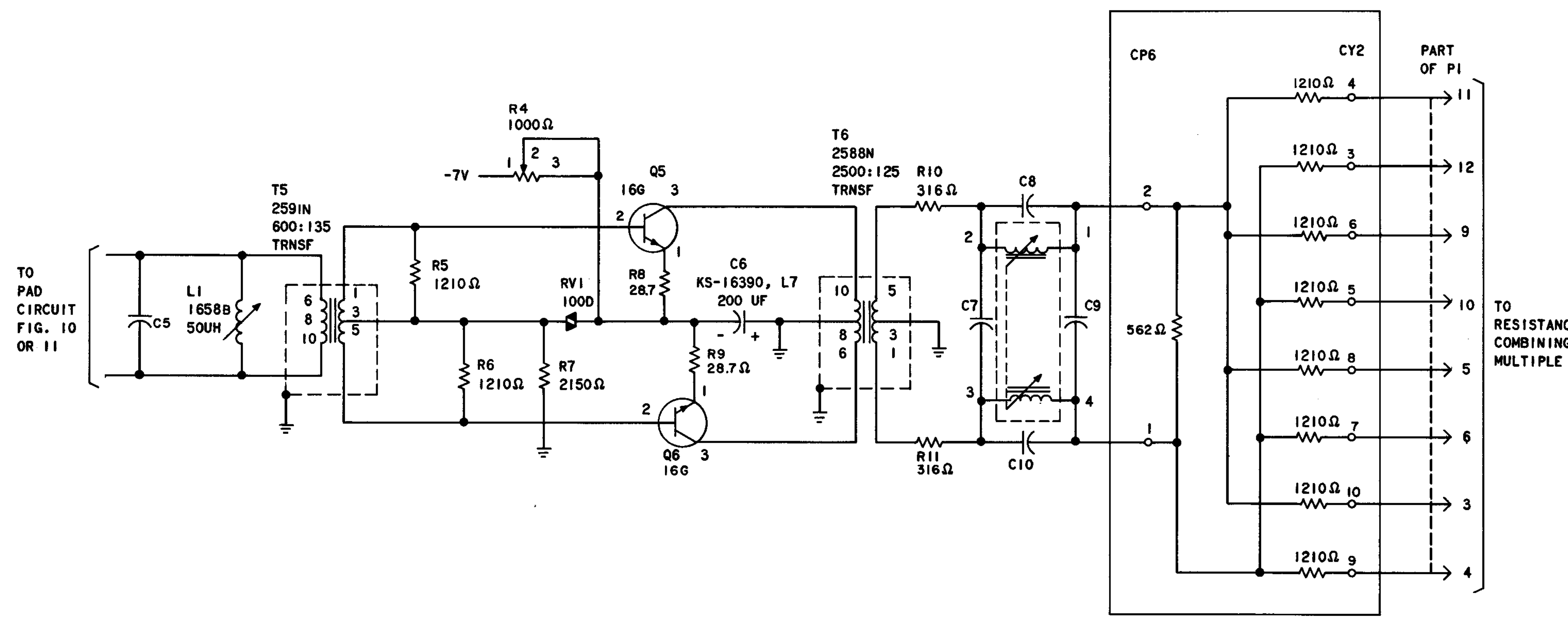

Fig. 12—Regulating Amplifier Circuit—Transmitted Carrier Output Taps

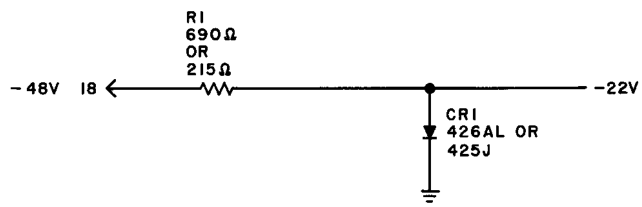

Fig. 13—Power Supply Circuit For Nonregulating Distribution Amplifier Circuits

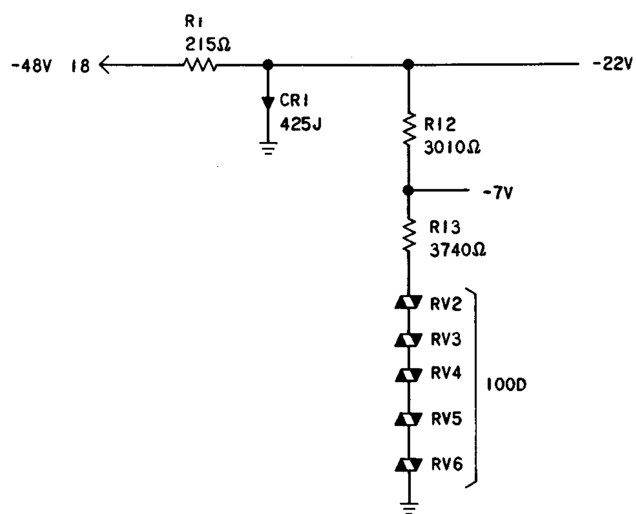

Fig. 14—Power Supply Circuit For Distribution Amplifier Circuits Employing Regulators