

2.2.3. Circuit Diagrams.

2.2.3.1. 150-W Power Amplifier.

Reference Designation 4400

The HF-input signal is fed to a bridge-T network (R101, R102, R103, R104, C101 and L101) doing a constant impedance frequency correction for the driver amplifier. The correction is approx. -12 dB at 1,6 MHz, -7,5 dB at 15 MHz and -6,5 dB at 30 MHz.

The driver amplifier is made up by Q101 and Q102 (BLX 13) forming a 10-W class-A push-pull stage.

The input is matched to 50 ohms by means of T101, which is a 2:1 unbalanced to balanced transformer (50-ohm unbal./12,5-ohm bal.). Low frequency input-impedance correction is performed by L102/R105 and L103/R106 insuring a low SWR figure over the entire frequency range.

The output-load impedance is 50-ohm balanced.

The DC stabilization is performed by the zenerdiodes CR101, CR102 and the dropping resistors R111, R135 maintaining a constant V_{ce} for Q101 and Q102 at between 25 V and 30 V.

Transistors with extremely low hFE value make it necessary to reduce the value of R107 or R108 for maintaining a V_{ce} below 30 V.

The collector currents are thus determined by the voltage drop across R111 and R135. As the V_{cc-Dr} supply voltage varies from 44,5 V to 40,0 V, the I_{cc-Dr} varies from 2,2 A to 1,5 A. This is the total current consumption for the driver stage and is monitored by means of the voltage drop across R113 fed to the instrument circuit of the "CF 6210/CF 6150" panel through R112 and R133 connected to P1-7 and P1-8. 3A will produce 100 mV across 100 ohms.

The driver output is switched either to the input of the power stage or directly to the HF-OUTPUT through a balanced to unbalanced 1:1 transformer T102 by means of the relays K101 and K102, so that the driver output is used directly at the reduced power levels "-12 dB" and "-18 dB". The relays are controlled from the "SYNTHESIS SE 6000" making a grounding of P1-4.

The output power amplifier is made up by Q103 and Q104 (BLX 15) forming a 150-W class-AB push-pull stage. Q103 and Q104 should be matched on hFE within +/- 12 per cent at 1.4 A, 6 V.

The input is matched to 50 ohms by means of T103, which is a 3:1 balanced to balanced transformer (50-ohm bal./5,55-ohm bal.). Frequency and impedance correction network is placed between the transformer T103 and the inputs of the two power transistors Q103 and Q104 (R114 through R121 and C119 through C124). C140 at the input of T103 improves the SWR in the high frequency range.

The output collector-collector load impedance is 12,5-ohms balanced and is matched to the required 50 ohms unbalanced by means of the 1:2 balanced to unbalanced transformer T104. The balancing transformer T105 improves the balance of the collector to collector load from T104 especially at low frequencies besides it serves as collector supply choke for Q103 and Q104. Low frequency compensation of T104 and T105 is performed by means of C130 and C131.

SECTION 1. TECHNICAL SPECIFICATION

General:

The ELEKTROMEKANO HF power amplifier PA 6150 is a wide-band all solid state linear HF power amplifier panel designed to be used in the ELEKTROMEKANO HF SSB/ISB transmitters S 76210 and S 76150. Its construction and reliability makes it attractive for use in other connections where an HF power of 500-600 W in the frequency range 1,6-30 MHz and low intermodulation distortion is required.

The power amplifier panel employs two independent 300-W amplifier units and a common forced air-cooling system.

Each 300-W amplifier unit is made up of two 150-W push-pull amplifiers containing a class-A driver amplifier and a class-AB output amplifier. The input signal for each 300-W amplifier unit is fed to an input splitter dividing the signal between the two 150-W amplifiers, the outputs of which are combined to provide the desired 300 W by means of an output combiner.

The amplifiers are protected against excess heat sink temperature by means of thermal switches mounted on each 150-W amplifier heat sink controlling the switching off of the 40 V DC supply for the 300-W amplifier unit.

Means are provided for measuring driver and output stage collector supply current and supply voltage.

A gain reduction of approx. 13 dB is possible by grounding a single control line, which by-passes the output stage and removes its bias.

Frequency Range:

1,6 - 30 MHz.

Gain:

36 dB +/- 2,5 dB.

Output Power:

Max. 300 W CW and PEP.

Harmonic Distortion:

2nd harmonic: less than -25 dBr
3rd harmonic: less than -15 dBr
at 300 W CW output.

Intermodulation:

Typically more than 35 dB below two-tone test signal level at max. output power.

Input and Output Impedance:

50 ohms.

Cooling:

Built-in blower with heat sink temperature supervision, max. 112°C.

Power Requirements: 40 V DC +/- 1 V, max. 37,5 A at
300 W CW output

41 V DC +/- 1 V, max. 28 A at
300 W PEP two-tone output

115 V AC +/- 10%, 50-60 Hz
65 V A for blower.

Environmental Conditions: Operating Temperature: -15°C to $+55^{\circ}\text{C}$
Storage Temperature: -40°C to $+70^{\circ}\text{C}$
Relative Humidity: 95% at 40°C

Shock and Vibration: According to MIL-STD-810B

Dimensions: Panel width: 19" (483 mm)
Panel Height: 180 mm
Panel Depth: 470 mm

Weight: 28 kg approx.

The necessary bias base voltage for achieving the required zero signal collector current independent of temperature and power level is supplied from the bias circuit made up by Q105 and Q106 forming a voltage stabilizer. The output voltage is determined partly by V_{BE} of Q106 and partly by the voltage drop across R134 giving a possibility for adjustment. Q106 is in good thermal contact with Q104, so that the change of V_{BE} of Q104 (and Q103) and Q106 with the temperature will be equal because of equal temperature coefficients. This temperature stabilizes the zero signal collector currents of Q103 and Q104.

The total collector current consumption of Q103 and Q104 is monitored by means of the voltage drop across R125, R126, R127 and R128 fed to the instrument circuit of the "CF 6210/CF 6150" panel through R131 and R132 connected to P1-5 and P1-6. 12 A will produce 100 mV across 100 ohms. The bias voltage is adjusted by means of R134 for a total zero signal collector current of Q103 and Q104 at 200 mA corresponding to an unloaded voltage at 5 mV between P1-5 and P1-6.

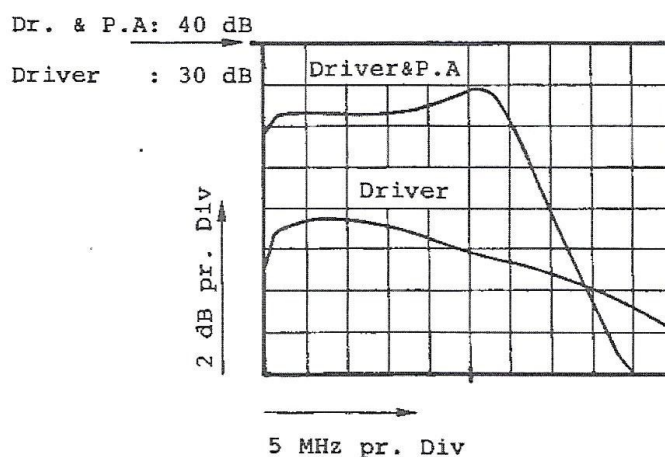
The bias voltage of Q103 and Q104 is removed in the reduced power levels, when the driver is used alone, by means of the relay K102.

The circuit is provided with a coaxial test jack J101 for the purpose of a possibility of a separate test of the output amplifier. For this the relay K101 is engaged by a grounding of the terminal named "PA test" (see photo at diagram no. 4400 in section 9.2.) thus switching the input of the output amplifier from the driver output to the test jack J101.

The power devices CR101, CR102, Q101, Q102, R111, R135, Q103, Q104 and R122 are all mounted on a common heat sink the temperature of which is maintained below 100°C up to an ambient temperature of 55°C by means of the built-in forced air-cooling system.

The heat sink temperature is supervised by means of the thermal switch ST1, with a nominal opening temperature of 112°C, connected to the "Error Logic" circuit in the "CF 6210/CF 6150" panel via P1-3 and P1-9 controlling the switching off of the HF input and power supply for the entire "300-W Amplifier Unit".

The following drawing shows the typical gain-frequency characteristic for partly the complete "150-W Power Amplifier" and partly the driver amplifier alone.



2.2.3.2. Input Splitter.
Reference Designation 4401

The circuit serves two purposes. Partly the splitting of the HF-input signal between the inputs of the two "150-W Power Amplifiers", and partly the distribution of DC power and collecting of measuring lines for the power amplifiers.

The signal splitter is made up by the hybrid transformer T525 with the associated out-of-balance resistor R525.

The 1,4:1 autotransformer T526 transforms the 50-ohm input impedance to the necessary 25-ohm input impedance for the hybrid transformer.

High frequency compensation is performed by means of C525 and C526.

The thermal switches ST1 of the two "150-W Power Amplifiers" are connected in series with each other, connected to the 40 V DC supply via the resistor R526 and J1-7 and finally fed to the "Error Logic" in the "CF 6210/CF 6150" panel via J1-8.

2.2.3.3. Output Combiner, 300 W.
Reference Designation 4402

The circuit combines the output signals from the two "150-W Power Amplifiers" fed to the input jacks J1 and J2 to 300 W output power at jack J3.

The combiner is made up by the hybrid transformer T530 with the associated out-of-balance resistors R530 through R534.

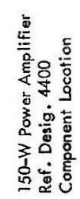
The 4:3 transformer T531 transforms the 50-ohm load impedance to the necessary 25-ohm load for the hybrid transformer.

Low frequency compensation of the combiner inputs J1 and J2 is performed by means of C531 and C532. The isolation between the inputs is more than 15 dB, when the output is loaded with 50 ohms.

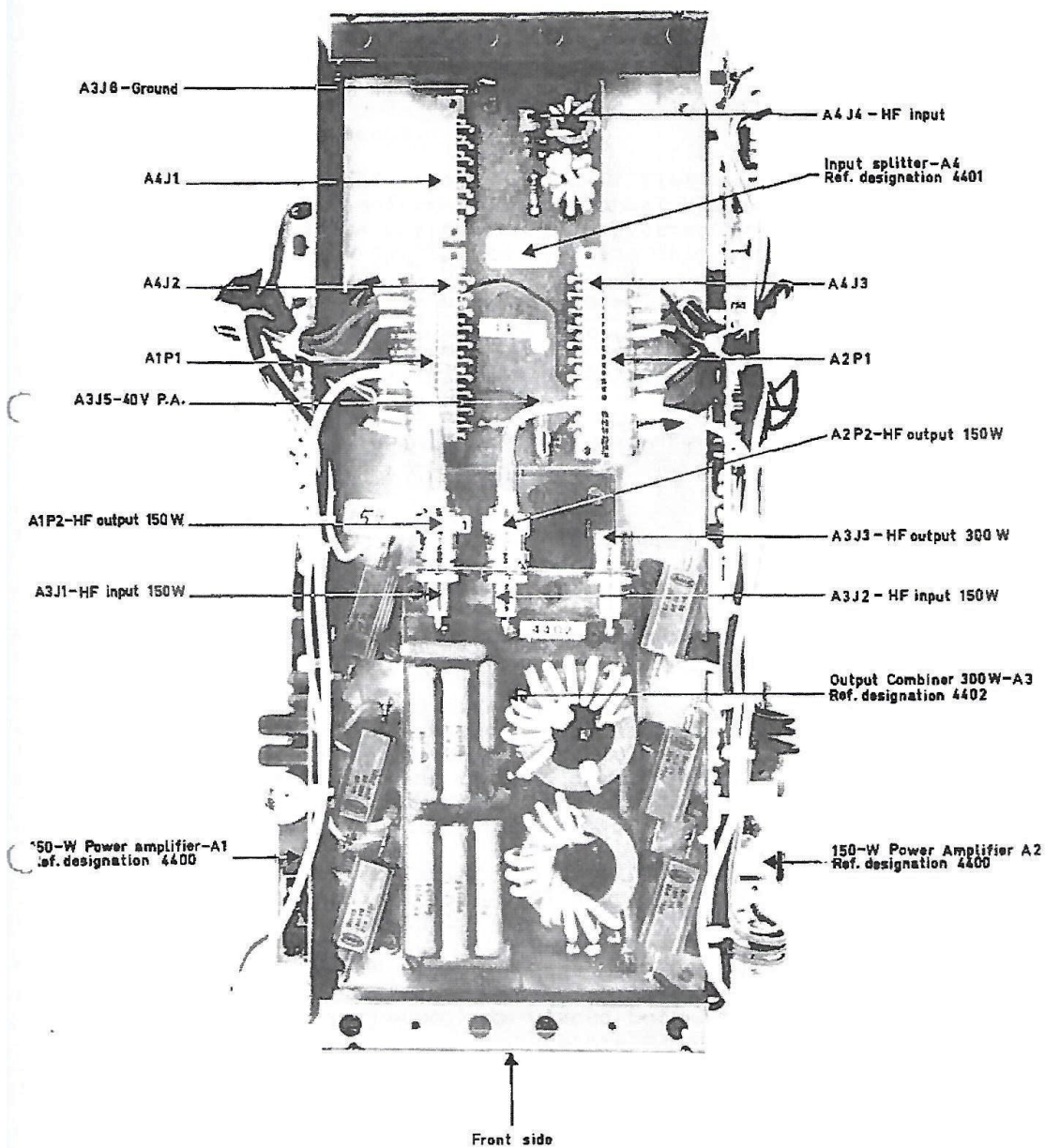
The insertion loss is maximum at 30 MHz and approx. 0,3 dB.

The maximum continuous difference between the two signal inputs is 35 V-eff corresponding to a dissipation at 12 W in the out-of-balance resistors. At a combined power level of 300 W this corresponds to input signals at $150 \text{ W} - 2 \text{ dB} = 95 \text{ W}$ and $150 + 1,6 \text{ dB} = 215 \text{ W}$, i.e. a difference of 3,6 dB.

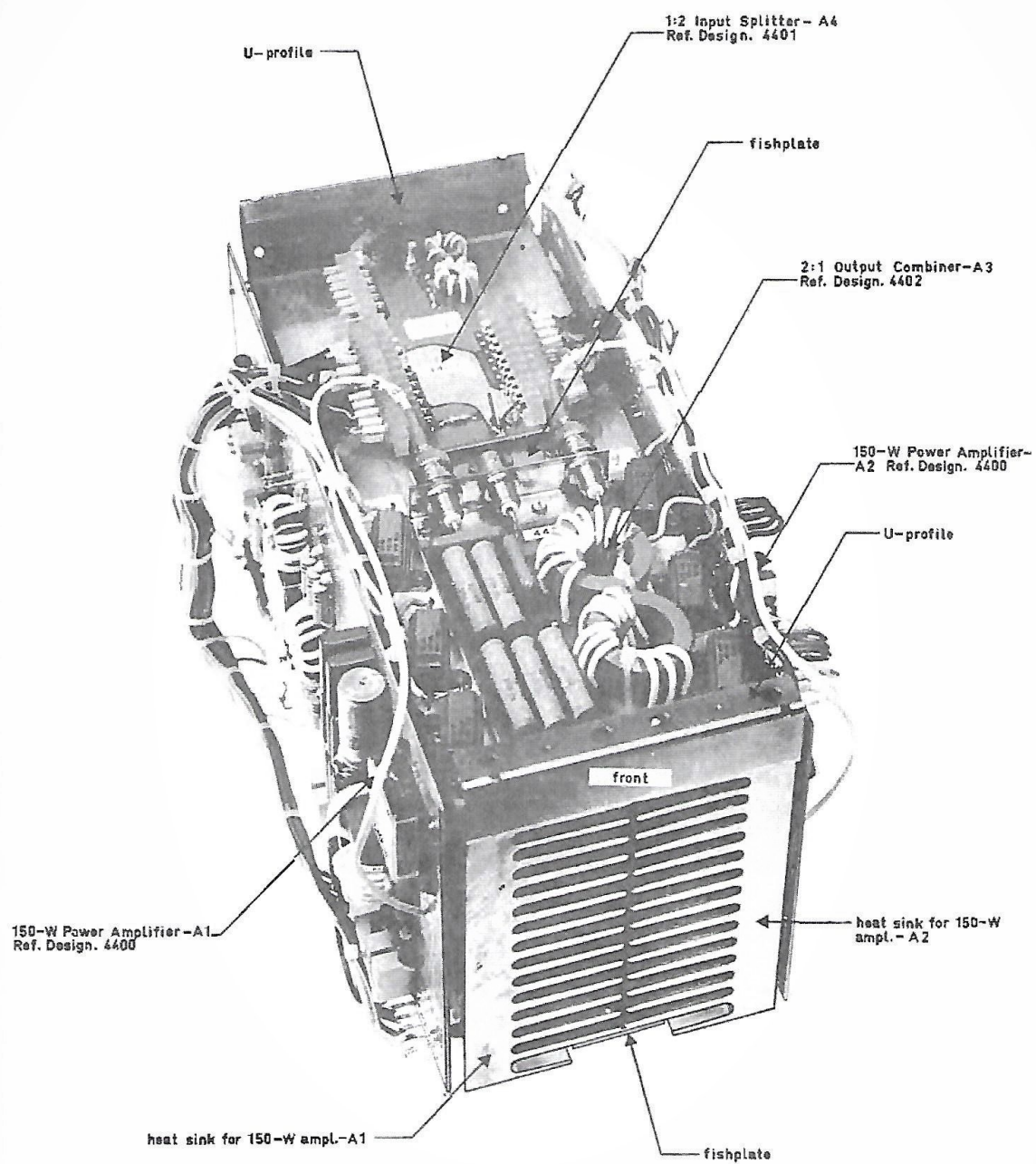
At a complete fall-out of one of the two "150-W Power Amplifiers", the power supply for the entire "300-W Unit" should immediately be removed or the out-of-balance resistors would be overloaded.



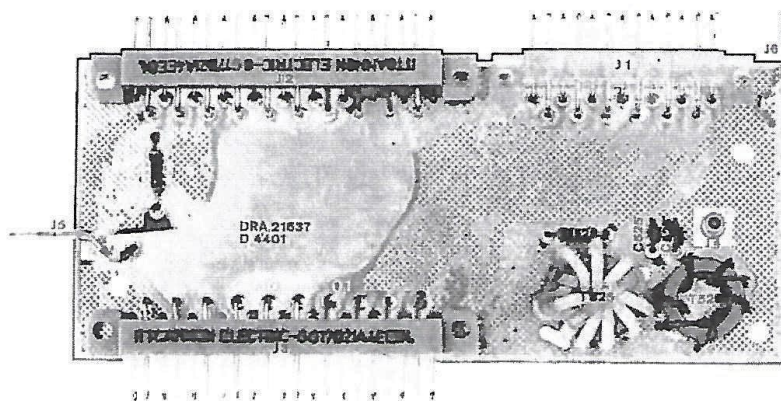
1
2
2



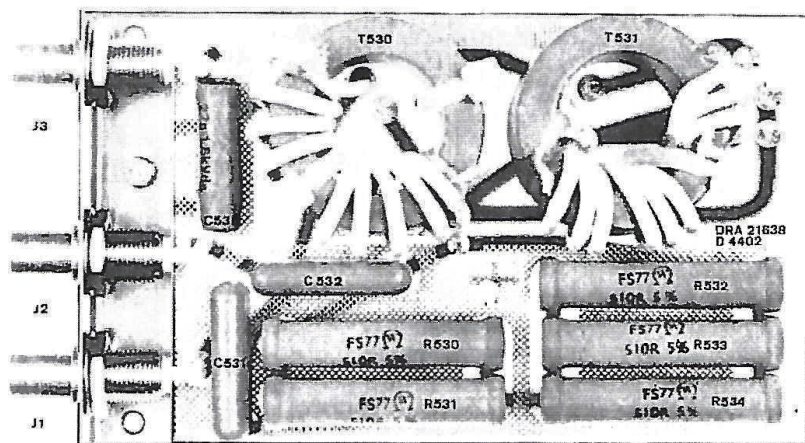
Top View, 300-W Amplifier Unit
Ref. Designation 4478



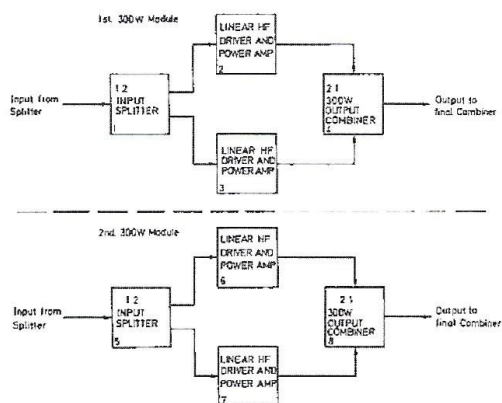
300-W Amplifier Unit
Ref. Designation 4478



Input Splitter
 Ref. Desig. 4401
 Component Location

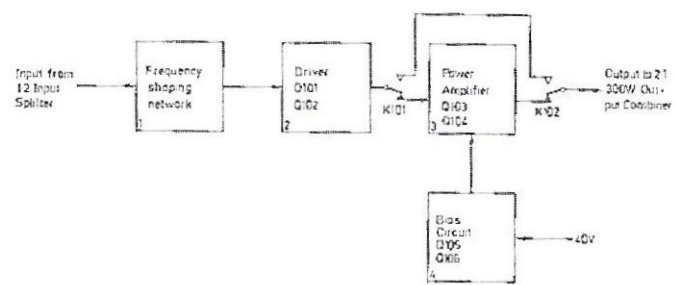


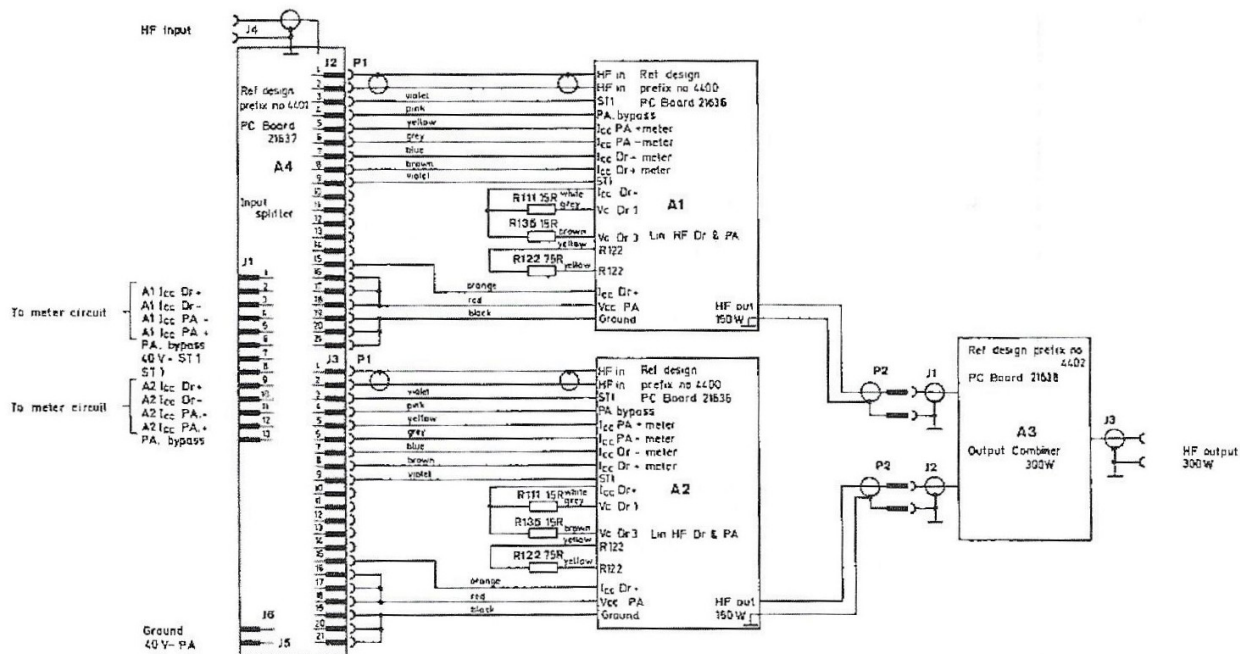
Output Combiner 300-W
 Ref. Desig. 4402
 Component Location



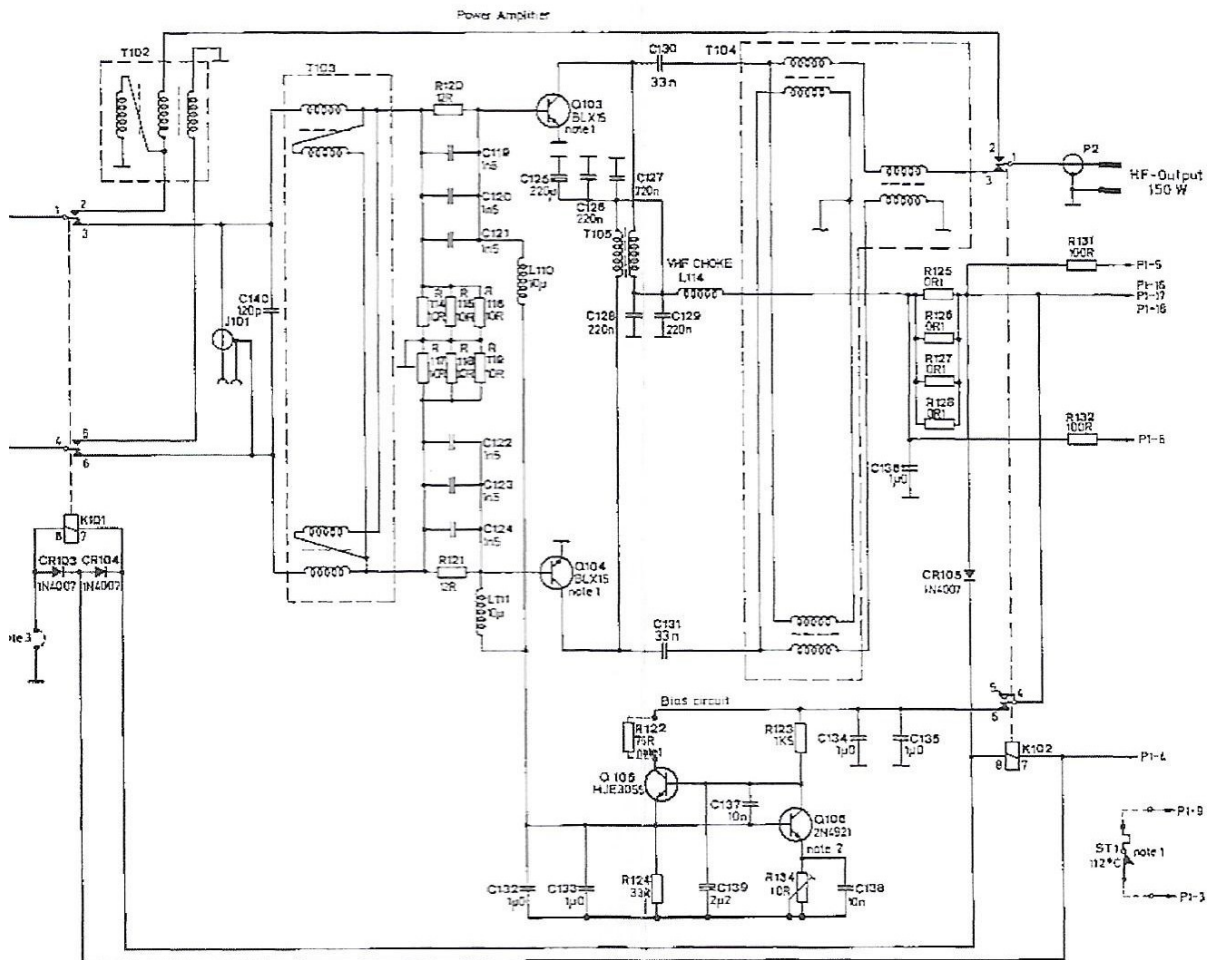
Block Diagram 500-W PA Panel

Ref. Designation 4445

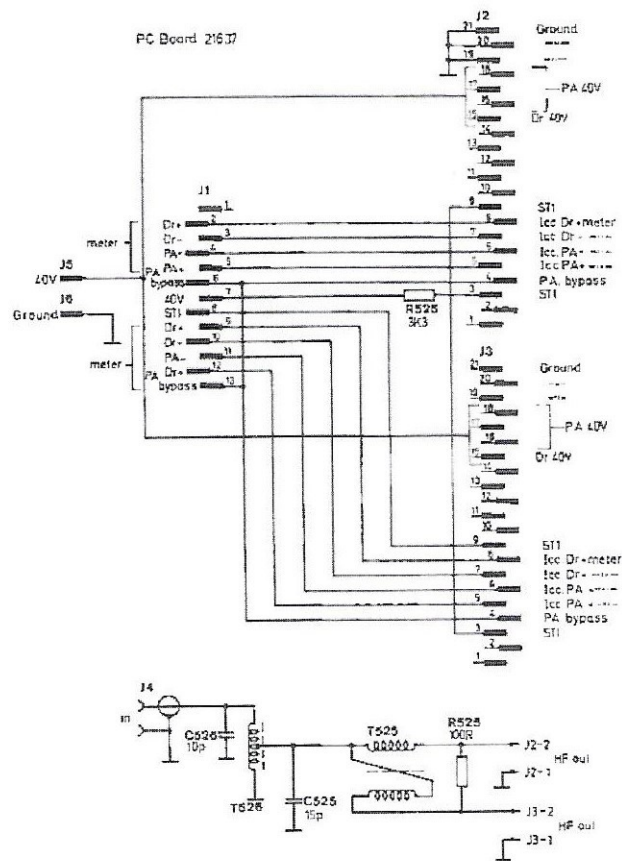




- Notes 1 Mounted on the heatsink
2 Q105 is in thermal contact with Q104
3 The jumper is used to allow K101 to be engaged, without K102 being engaged, for P.A. test purposes



150-W Power Amplifier
Ref. Designation 4400



Note 1:

Partial Reference Designations are shown. For complete Designation prefix with Assembly and Subassembly Reference Designations (Circuit Diagram Nos.)

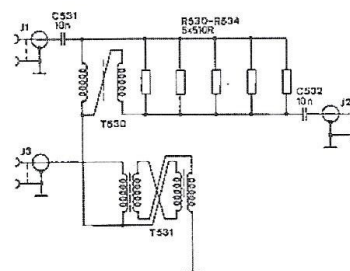
Note 2:

The code system used for indicating resistance values corresponds to that specified in IEC 62, with the exception that decimal fractions are used for values below 1Ω, e.g., 0.47 = 0.47Ω, but 4.7 = 4.7Ω.

The capacitance units are indicated by means of the international prefixes p, n, and μ, (pF, nF, and μF).

The inductance units are indicated by means of the international prefixes μ, and m, (μH, and mH).

P.C. Board 21638



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