SERVICE INSTRUCTION

NAP10/1

1.25kW AM POWER SUBSYSTEM MODULE

ORIGINAL ISSUE – 01 JUNE 1986
CHANGE 1 (INCORPORATED) – 15 FEBRUARY 1988
CHANGE 2 (INCORPORATED) – 01 DECEMBER 1989

nautel

LIST OF EFFECTIVE PAGES

The list of effective pages lists the status of all pages in this manual. Pages of the original issue are identified by a zero in the Change No. column. Pages subsequently changed are identified by the date of the change number. On a changed page, the text affected by the latest change is indicated by a vertical bar in the margin opposite the changed material.

Original . . . . 01 June 1986
Change 1 . . . . 15 February 1988
Change 2 . . . . 01 December 1989

Total number of printed sides in this manual is 27 as listed below:

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Title (rear)	-	Blank	14	2	01 December 1989
Effective (1)	2	01 December 1989	15	2	01 December 1989
Effective (2)	-	Blank	16	2	01 December 1989
1	0	01 June 1986	17	1	Deleted
2	0	01 June 1986	18	1	Deleted
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INTRODUCTION

1. The NAP10/1 1.25 kW AM power subsystem module (1.25 kW power module) is a wide band, rf power amplifier that contributes up to 1.25 kW of unmodulated rf carrier power, over the AM broadcast frequency band. Troubleshooting and repair of the module is performed on a work bench, independent of its associated transmitter. This document provides the information required for a competent technician to understand the operation of electrical circuits and the procedures to restore a defective module to a serviceable status.

FACTORY EXCHANGE/REPAIR SERVICE

2. An alternative to procedures provided in this document is to utilize Nautel's module exchange/repair service facilities. Nautel provides a factory module exchange/repair service for users of Nautel's AMPFET series of transmitters. Users who do not have repair facilities or who are not able to repair a module may utilize this service for a nominal fee.

MECHANICAL CONFIGURATION

3. The NAP10/1 1.25 kW AM power subsystem module comprises a fabricated metal chassis with a full-depth front panel, the chassis supports and houses three NAA13 modulator/power amplifier assemblies (PA assemblies), three storage capacitors and a cooling air fan. A fabricated metal bracket at the rear of the chassis contains two fixed mating connectors J1 and J2. Terminal board TB1 is mounted adjacent to rear storage capacitor and a tunning coil assembly is mounted directly above the terminal board. The overall dimensions are approximately eight inches (20 cm) high, nine inches (23 cm) wide and sixteen inches (41 cm) deep. It weighs approximately 25 pounds, (11 kilograms). All external wiring connections are made to connectors J1 and J2 at the rear section of the 1.25 kW power module.

3.1 CHASSIS (see figures FO-3 thru FO-7): The chassis and its attached front panel are fabricated from sheet aluminum. The upper portion of the chassis supports a fabricated metal configuration that encloses three individual NAA13 modulator/power amplifier assemblies. Three storage capacitors C1 thru C3 are situated adjacent to this housing and are secured to the chassis. Tunning coil assembly (L1) is contained in a small metal housing which is secured to the PA assembly housing. A vertical bracket at the rear section of the chassis contains two fixed mating connectors J1 and J2 plus a B- voltage lamp. The inner portion of the chassis contains three rf transformers T1, T2 and T3; current shunt resistor R4; terminal boards TB1/TB2 of each associated PA assembly and a -72 volt dc metal plate. A forced air cooling fan (muffin type), is mounted at the rear section of the chassis and attached to the PA assembly housing. INPUT CURRENT meter M1, three PA FAIL lamps A/B/C and PA VOLTS test point TP1 are located on the front panel. A handle is installed on the front panel to facilitate removal of the subsystem from the transmitter. Holes on the front panel provide exhaust ports for the forced air cooling system.

3.2 NAA13 MODULATOR/POWER AMPLIFIER ASSEMBLY (see figures FO-8 and FO-9): The PA assembly uses an extruded, finned heat sink as its chassis. The power MOSFET's and all heat dissipating components are mounted directly to the heat sink while the remainder are installed on three single-sided printed circuit boards. External and internal electrical connections are made at terminal boards TB1 and TB2, two insulated feed-thru connectors E1 and E2 provide input terminals for the B- supply.

OVERVIEW DESCRIPTION

4. The overview description is a brief explanation based on the functional blocks of the NAP10/1 1.25 kW AM power subsystem module. Refer to paragraph 5 for a more detailed description.

4.1 NAP10/1 1.25 kW AM POWER SUBSYSTEM MODULE OVERVIEW (see figure FO-1): The 1.25 kW power module contributes up to 1.25 kW of unmodulated rf carrier power over the AM broadcast frequency band. A -72 volt dc signal is passed to shunt resistor R4, INPUT CURRENT meter M1, connected in parallel with R4, monitors the combined current level of the three PA assemblies. B- lamp DS4 turns on when the -72 volt dc signal is present and capacitors C1 thru C3 provide smoothing and storage. The -72 volt dc signal, 'rf drive' and 'mod drive' inputs are applied simultaneously to the three PA assemblies. The outputs of the PA assemblies are coupled through impedance matching transformers T1 thru T3, the secondary of the transformers are connected in series and combine the three outputs of the PA assemblies to produce the desired rf carrier output signal. Inductor L1 provides fine tuning and tap selection for the rf drive input at J1-7/4 (tap selection and tuning of inductor L1 will not be required unless the assigned carrier frequency is changed). PA FAIL-A lamp DS1; PA FAIL-B lamp DS2; and PA FAIL-C lamp DS3, located on the front panel will turn on should a failure occur within their respective PA assemblies. Cooling fan B1 turns on when ac power is applied to the 1.25 kW power module. PA VOLTS test point TP1, located on the front panel, indicates the combined voltage being applied to the three PA assemblies.

4.1.1 NAA13 MODULATOR/POWER AMPLIFIER ASSEMBLY OVERVIEW (see figure FO-1 and FO-2): PA assemblies A1, A2 and A3 each produce approximately 400 Watts of the 1.25 kW unmodulated rf output. Current imbalance and temperature sensing protection circuitry remove the mod drive input should a failure occur within an individual PA assembly this effectively provides protection for rf and modulator power MOSFET's. When either fault mentioned above occurs, a resistor to ground path is produced for the 'PA fail sense' input signal at TB2-4, a PA fail-alarm lamp (A, B or C) will turn on at the front panel.

NOTE

Failure of a modulator circuit within an individual PA assembly does not shut the 1.25 kW power module down, and a PA fail-alarm lamp will not turn on. If a modulator should fail, a decrease in current will be indicated at INPUT CURRENT meter M1. To isolate/repair a defective modulator, refer to troubleshooting/repair steps in paragraph 7.

4.1.1.1 Modulator Overview: The 'mod drive' input is applied to a balanced drive switching circuit. When the 'mod drive' input is high, the balanced drive output is high. When the 'mod drive' input is low, the balanced drive output is low. The resultant output of the balanced drive switching circuit will be a rectangular waveform at the pulse width modulator frequency, the waveform will be switching from the B- voltage to a voltage that is less negative and applied simultaneously to the gates of two modulator power MOSFET's.

4.1.1.2 Low-pass Filter Printed Circuit Board A3 Overview: Low-pass filter pcb provides a smoothed negative dc voltage with audio superimposed. The output of the low-pass filter circuit is controlled by the on/off ratio of the modulators power MOSFET's and the fast attack slow recovery circuit within the filter. One output of the filter is applied to the power amplifier circuit, the second output is applied through a resistor to terminal board TB2-3 and passed to test point TP1, this represents the modulators voltage being applied to the rf power MOSFET's.

4.1.1.3 Power Amplifier Overview: The power amplifier is a class 'D' switched- mode rf power amplifier, switching of the power MOSFET's is controlled by the rf drive frequency. The output of the power amplifier is passed to the primary of an impedance matching transformer, the secondary winding is connected in series with the two other power amplifiers and the combined output represents the rf carrier output of the 1.25 kW power module. A PA FAIL-ALARM lamp (A, B or C), located on the front panel, will turn on should a failure occur within the power amplifier. Test point TP1 (PA VOLTS), located on the front panel, measures the dc (B-) voltage of the three PA assemblies.

4.1.1.4 Current Imbalance Detector Printed Circuit Board A1 Overview: Under normal operating conditions current imbalance circuit has no influence. Should a fault occur in the power amplifier circuit (rf power MOSFET failure), an ac voltage will be developed across a polarity wound transformer, the signal will be detected by a half-wave rectifier and the resultant dc output passed to the gate of a 'mod drive crowbar' device, the device will be gated on. When the crowbar device turns on it provides a ground path for the 'PA fail sense' dc voltage turning on one of three PA fail-alarm lamps on the front panel. A ground is also applied to the mod drive input line, this effectively clamps 'mod drive' input at terminal board TB2-6 to ground providing protection for the rf power MOSFET's.

4.1.1.5 Temperature Sensor Overview: Under normal operating conditions the temperature sensor circuit has no influence. When operating temperature increases above 69 degrees C, the temperature sensor circuit turns on applying a dc signal to a 'mod drive crowbar' device, the device will be gated on. When the crowbar device turns on it provides a ground path for the 'PA fail sense' dc voltage, this turns on a PA fail-alarm lamp on the front panel. A ground is also applied to the mod drive input line, this effectively clamps 'mod drive' input at terminal board TB2-6 to ground providing protection for the rf power MOSFET's.

4.1.1.6 Fault Switch Overview: Under normal operating conditions the fault switch circuit has no influence. When a current imbalance or high temperature fault occurs, the fault switch circuit turns on. The resultant output is applied to the gate of a 'mod output crowbar' device and the device is gated on. When the 'mod output crowbar device turns on, it provides a ground path for the modulators B- voltage. This also provides transient protection the modulator's power MOSFET's from transients.

THEORY OF OPERATION DETAILED

5. The following explanations are the detailed circuit description of the overviews described in paragraph 4 using the electrical schematics as a reference.

5.1 NAP10/1 1.25 kW AM POWER SUBSYSTEM MODULE DESCRIPTION (see figures FO-1 and FO-2): The 1.25 kW power module contributes up to 1.25 kW of unmodulated rf carrier power over the AM broadcast frequency band for its associated AMPFET transmitter. A -72 volt dc signal is passed to shunt resistor R4. INPUT CURRENT meter M1, connected in parallel with R4, monitors the combined current level of the three PA assemblies. B- lamp DS4 turns on when the -72 volt dc signal is present and capacitors C1 thru C3 provide smoothing and storage. The -72 volt dc signal, 'rf drive' and 'mod drive' inputs are applied simultaneously to three PA assemblies. Outputs of the PA assemblies are coupled through impedance matching transformers T1 thru T3, the secondary of the transformers are connected in series and combine the three outputs of the PA assemblies to produce the desired rf carrier output signal. Inductor L1 provides fine tuning and tap selection for the rf drive input at terminal board TB2-1 (tap selection and tuning of inductor L1 will not be required unless the assigned carrier frequency is changed). PA FAIL-A lamp DS1; PA FAIL-B lamp DS2; and PA FAIL-C lamp DS3, located on the front panel, will turn on should a current imbalance or high temperature failure occur within their respective PA assemblies. Cooling fan M1 turns on when ac power is applied to the 1.25 kW power module. PA VOLTS test point TP1 indicates the dc (B-) voltage being applied to the PA assemblies.

5.1.1 NAA13 MODULATOR/POWER AMPLIFIER ASSEMBLY DESCRIPTION: PA assemblies (A1, A2 and A3) each produce approximately 400 Watts rf carrier power for their associated 1.25 kW power module. PA assembly circuits contain temperature and current protection devices which remove the 'mod drive' input should a failure occur and turn on a PA FAIL-ALARM lamp (A, B or C) on the front panel.

5.1.1.1 Modulator Printed Circuit Board A2 Description: The 'mod drive' (zero to +15 volt dc pulses) at TB2-6 is passed across resistors A2R4/5 and applied to the emitter of switching transistor A2Q3. When the input signal being applied to the emitter of transistor A2Q3 is positive, A2Q3 will be forward biased. When the input signal being applied to A2Q3 is negative A2Q3 will be reversed biased. The bases of transistors A2Q4 and A2Q5 will be switching between -59 and -72 volts dc.

Transistors A2Q4 and A2Q5 and their associated components form a balanced drive switching circuit for modulator power MOSFET's Q1 and Q2. Zener diode A2CR2 and resistor A2R6 establish a reference voltage which is 13 volts dc less negative than the B- voltage, this reference voltage is applied to the collector of A2Q4. When the bases of transistors A2Q4 and A2Q5 are at the B- level, A2Q4 will be reverse biased, A2Q5 will be forward biased. The voltage at the junction of A2Q4 and A2Q5 emitters will be at the B- level and MOSFET's Q1 and Q2 will be switched off. When the bases of A2Q4 and A2Q5 are at -59 volts dc, A2Q4 will be forward biased, A2Q5 will be reverse biased, MOSFET's Q1 and Q2 will be switched on. The output at the junction of transistors A2Q4 and A2Q5 will be a rectangular waveform at the pulse width modulator switching frequency switching from the B- voltage to a voltage approximately 13 volts less negative than the B- voltage.

5.1.1.2 Low-pass Filter Printed Circuit Board A3 Description: Inductors A3L1 thru A3L3 and capacitors A3C1 thru A3C5 comprise a low-pass filter network that produces a filtered negative dc voltage. The voltage is proportional to the on/off ratio of the nominal (PWM) 70 kHz rectangular waveform applied to gates of modulator MOSFET's Q1 and Q2. The output of MOSFET's Q1/Q2 is applied through A3L1 to capacitors A3C1, A3C2 and A3C4. The capacitor network will charge towards the B- voltage. When MOSFET's Q1/Q2 turn off, capacitors A3C1/A3C2/A3C4 will discharge through the load presented by the power amplifier stage. The fast attack, slow recovery action of this circuit results in the output of the low pass filter being the average value, this is determined by the on/off ratio of modulator power MOSFET's Q1 and Q2, for example; when the on/off ratio is 50 percent, the voltage on the capacitor network will be approximately half of the B- voltage. Free wheeling diode CR1 shunts positive voltage spikes that occur when current flow through the inductors is switched on and off. Inductors A3L1 thru A3L3 and capacitors A3C1 thru A3C5, form a filter circuit that removes the nominal 70 kHz switching frequency but allows audio information to pass without attenuation. The resultant negative dc voltage with superimposed audio is applied to the power amplifier switching circuit as the modulator output voltage. A sample of this voltage is also applied through resistor R2 to terminal board TB2-3, this output signal is utilized for metering purposes and represents the level of modulator voltage being applied to the rf power MOSFET's.

NOTE

If free wheeling diode CR1, (anode connected to modulator power MOSFET's Q1 and Q2) or 'mod output crowbar' thyristor Q11 fail there is reason to suspect that modulator power MOSFET's Q1 and Q2 will be overdriven and fail. In most instances this will cause transistors A2Q4 and A2Q5 to fail.

5.1.1.3 Power Amplifier Description: The rf drive is applied to the primary of transformers T1 and T2 from the primary of transformer A1T1. The output of each secondary winding is applied across the gate and source leads of rf power MOSFET's Q3 thru Q10. When the gate of a MOSFET device is positive relative to its source, the device will be turned on. When the gate is negative, relative to its source, the device will be turned off. A hot carrier diode is placed across the source/drain junction of each rf power MOSFET, this ensures switching transients do not damage the device. The secondary of transformers T1/T2 are configured to ensure that the voltage applied to MOSFET's Q3/Q6 and Q7/Q10 (push-pull arrangement) are in phase and that the voltage applied to MOSFET's Q4/Q5 and Q8/Q9 are in phase.

The voltage applied to rf power MOSFET's Q3/Q6 and Q7/Q10 is 180 degrees out of phase with the voltage applied to power MOSFET's Q4/Q5 and Q8/Q9. When Q3/Q6 and Q7/Q10 are turned on, Q4/Q5 and Q8/Q9 will be turned off. Current will flow from the modulator output voltage source, through the source/drain junction of Q3/Q7 to TB1-1, through the primary windings of impedance matching transformer (T1 of figure FO-1), through TB1-2, through the source/drain junction of Q6/Q10 to ground. During the next half cycle, Q3/Q6 and Q7/Q10 are turned off, power MOSFET's Q4/Q5 and Q8/Q9 will be turned on. Current will flow from the modulator output voltage source, through the source/drain junction of Q5/Q9, through TB1-2, through the primary windings of impedance matching transformer T1 (in the reverse direction), through TB1-1, through the source/drain junction of Q4/Q8 to ground. The resultant rf output on the secondary of T1 is combined with the output of the two PA assemblies located in the 1.25 kW power module. This combined output totals up to 1.25 kW and is passed out J2-1/2.

5.1.1.4 Current Imbalance Detector Printed Circuit Board A1 Description: Under normal operating conditions the rf drive is applied to the primary of transformer A1T1 through terminal board TB2-1/2. Transformer A1T1 has two balanced windings that are polarity wound. The current through the two primary windings is of equal value and cancel each other, this results in a zero output from the secondary, the circuit will have no influence. Should a fault occur in the power amplifier circuitry, (rf power MOSFET failure) a current imbalance is produced between the two primary windings of transformer A1T1, an ac signal is coupled through the secondary and detected by half-wave rectifier A1CR1, the output of A1CR1 is applied to the gate of thyristor A1Q1, A1Q1 is gated on. This applies a resistor to ground path for the 'PA fail sense' +24 volt dc signal being applied at terminal board TB2-4 turning on a PA FAIL-A lamp DS1; PA FAIL-B lamp DS2; or PA FAIL-C lamp DS3 on the front panel. A resistor to ground path is also applied to the emitter of transistor A2Q3, A2Q3 will be reversed biased and the 'mod drive' input signal being applied through terminal board TB2-6 will be applied through diode A2CR1 and transistor A1Q1 to ground providing protection for the rf power MOSFET's. A resistor to ground path is also applied to the base of transistor A2Q2, A2Q2 will be forward biased.

5.1.1.5 Temperature Sensor Description: Under normal operating conditions transistor A2Q1 is reversed biased, the temperature sensor circuit will have no influence. Thermistor A2RT1 has a negative coefficient, as temperatures rise the resistive value of A2RT1 decreases, when the temperature exceeds 69 degrees C, the voltage at the junction of resistor A2R1 and A2RT1 will be more positive than the voltage being applied through zener diode A2CR3 to A2Q1 emitter, A2Q1 will be forward biased. Current will flow through resistor A1R2 to the gate of thyristor A1Q1, A1Q1 is gated on. This applies a resistor to ground path for the 'PA fail sense' +24 volt dc signal being applied at terminal board TB2-4 turning on a PA FAIL-A lamp DS1; PA FAIL-B lamp DS2; or PA FAIL-C lamp DS3 on the front panel. A resistor to ground path is also applied to the emitter of transistor A2Q3, A2Q3 will be reversed biased and the 'mod drive' input signal being applied through terminal board TB2-6 will be passed through resistor A2R4, diode A2CR1 and transistor A1Q1 to ground providing protection for the rf power MOSFET's. A resistor to ground path is also applied to the base of transistor A2Q2, A2Q2 will be forward biased.

5.1.1.6 Fault Switch Description: Under normal operating conditions transistor A2Q2 is reversed biased, the fault switch circuit will have no influence. Should a current imbalance or high temperature fault occur transistor A2Q2 will turn on. The output from the collector of A2Q2 is passed to the gate of thyristor Q11, Q11 will turn on. This provides a ground path for the modulator's negative dc voltage and effectively clamps it to ground providing protection for the modulators power MOSFET's by preventing any transients from entering the circuit.

FUNCTIONAL TEST

6. Functional testing of a NAP10/1 1.25 kW AM power subsystem module on a work bench requires specialized test equipment not normally available outside of the factory. The only practical method of functionally testing a 1.25 kW power module in the field is to install it in an AMPFET transmitter and verify it is contributing to the transmitters rf output. The AMPFET transmitter utilizes fault detection circuits which are incorporated into their design that automatically inhibit the output of an individual PA assembly, within a 1.25 kW power module, which is not contributing its share to the transmitter's rf output.

CAUTION

Observe the operating precautions noted in section 4 of the AMPFET 50 transmitter's instruction manual when removing 1.25 kW power modules from a transmitter. Damage to mating connectors or destruction of solid state devices may result if a 1.25 kW power module is removed when the transmitter is turned on.

TROUBLESHOOTING/REPAIR

7. Troubleshooting of the NAP10/1 1.25 kW AM power subsystem module consists of visual inspection and resistance measurements. Isolate a defective component or fault in the 1.25 kW power module as follows:

7.1 SPECIAL TOOLS AND TEST EQUIPMENT: A digital multimeter is required: the multimeter must be able to measure the forward/reverse resistance of a diode for checking the PA assemblies rf and modulator power MOSFET's. A torque wrench capable of torquing to five inch pounds, (0.57 Newton meters or 0.58 kilograms) is required for reassembly.

7.2 VISUAL INSPECTION: Perform the visual inspection as follows:

(a) Inspect all electrical devices for any physical defects.

(b) Inspect all solder connections for good mechanical bond and adequate solder.

(c) Verify connectors J1 and J2 do not contain damaged or loose pins and that they are securely fastened to the rear fabricated bracket.

(d) Verify all wiring insulation is intact and is not frayed, broken or otherwise damaged.

(e) Verify wire conductors are not pinched or damaged and do not contain broken wire strands.

(f) Verify that the muffin cooling fan is not jammed and its blade rotates freely.

(g) Verify that the six B- screws, (A1E1 thru A3E2) located on the -72 volt dc plate, are making good contact and are not stripped (see figure FO-6).

(h) Replace any component or wiring that does not meet requirements of the visual inspection, ensuring leads of replacement wiring and passive components are kept to the shortest length possible without causing mechanical stress to component or lead.

Table 1 Resistance Measurements (1.25 kW Power Module Fully Assembled)

OHMMETER CONNECTIONS (meter set to non-diode position)		OHMMETER INDICATIONS	
POSITIVE LEAD	NEGATIVE LEAD	NORMAL	ABNORMAL
A1TB1-1	Ground	more than 1000 ohms	less than 1000 ohms
A2TB1-1	Ground	more than 1000 ohms	less than 1000 ohms
A3TB1-1	Ground	more than 1000 ohms	less than 1000 ohms
Ground	A1TB1-1	OPEN	SHORT
Ground	A1TB1-2	OPEN	SHORT
Ground	A2TB1-1	OPEN	SHORT
Ground	A2TB1-2	OPEN	SHORT
Ground	A3TB1-1	OPEN	SHORT
Ground	A3TB1-2	OPEN	SHORT
A1E1	Ground	more than 2K ohms	SHORT
Ground	A1E1	more than 2K ohms	SHORT
A2E1	Ground	more than 2K ohms	SHORT
Ground	A2E1	more than 2K ohms	SHORT
A3E1	Ground	more than 2K ohms	SHORT
Ground	A3E1	more than 2K ohms	SHORT

7.3 RESISTANCE MEASUREMENTS PRIOR TO DISASSEMBLY: Prior to disassembly of the 1.25 kW power module, the following resistance measurements should be completed (see table 1):

7.4 DISASSEMBLY: Disassemble the 1.25 kW power module, to the extent necessary to gain access to defective parts, as follows:

7.4.1 Removal of NAA13 Modulator/Power Amplifier Assemblies (see figure FO-6): Remove each PA assembly as follows:

(a) Gain access to the underside of the 1.25 kW power module by placing it on one side as depicted in figure FO-6.

(b) Disconnect transformer leads from TB1 (A1, A2 or A3 as appropriate).

(c) Loosen screws securing fanning strip to XTB2 to terminal board TB2 (A1, A2 or A3 as appropriate) and then disconnect fanning strip from terminal board.

(d) Remove two screws attaching -72 volt dc plate to B- terminals E1 and E2 (A1, A2 or A3 as appropriate).

CAUTION

Extreme care must be taken when removing PA assembly to avoid damage to pot cores of inductors A3L1 thru A3L3 in their respective low-pass filters (see figure FO-2).

(e) Remove the two screws attaching PA assembly (A1, A2 or A3 as appropriate) to 1.25 kW power module chassis (one screw is located adjacent to E2 and the other at the extreme left)and then carefully extract PA assembly from the top side of the chassis.

7.5 ISOLATION OF DEFECTIVE POWER MOSFET's: Isolate defective power MOSFET devices in PA assemblies, using a digital multimeter that is capable of measuring the forward/reverse resistance of a diode, as follows:

NOTE

The following procedures require the power MOSFET under test to be turned on by the application of a dc voltage (minimum of 4.0 volts dc to a maximum of 9.0 volts dc) between its gate and source. Some digital multimeters have sufficient dc voltage on their test leads when they are set to 'diode' or 'resistance' test positions. If the digital multimeter to be used falls in this category, it may be used as the voltage source. If it does not, a dc voltage source that is between 4.0 and 9.0 volts dc must be obtained.

(a) Unsolder and disconnect wiring from gate of modulator MOSFET's (Q1 and Q2) and power amplifier MOSFET's (Q3 thru Q10) to be tested.

(b) Verify the power MOSFET to be tested is turned off, by momentarily connecting a jumper between its gate and ground.

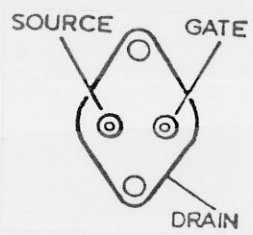
(c) Measure source/drain resistance, of power MOSFET being tested, in both directions.

(d) Resistance measurements in step (c) shall be an open circuit in the reverse bias direction and a diode pedestal in the forward bias direction.

(e) If requirements in step (d) are not met, unsolder and disconnect wiring from the source and drain terminals of MOSFET's that are suspected of being defective and repeat steps (b) thru (d).

(f) Turn on the power MOSFET to be tested by momentarily applying a dc voltage (4.0 to 9.0 volts dc) between its gate (+) and source (-) leads.

(g) Measure source/drain resistance, of power MOSFET being tested, in both directions.



(h) Resistance measurements in step (g) shall be a short circuit in forward and reverse directions.

(i) Measure resistance between the drain (case), of power MOSFET's Q1, Q2, Q3, Q5, Q7 and Q9 and the heat sink (ground) in both directions.

(j) Resistance measurements in step (i) shall be an open circuit in one direction and a diode pedestal in the other direction.

(k) If requirements of steps (d), (h) and (j) are met, the power MOSFET being tested may be assumed to be serviceable.

(l) If requirements of steps (d), (h) and (j) are not met, the power MOSFET being tested or, where applicable, its insulating washer may be assumed to be defective. Replace the defective power MOSFET as detailed in paragraph 7.6.

7.6 POWER MOSFET REPLACEMENT: Replace defective power MOSFET's as follows:

(a) Unsolder the applicable leads of the power MOSFET to be replaced, ensure solder is not splattered on the chassis.

NOTE

When removing a power MOSFET, note the type of insulator between it and the heat sink. Pay particular attention to the type and color of the insulator and whether it is coated with thermal compound or not.

(b) Remove attaching hardware from the power MOSFET to be replaced and remove MOSFET. Note type of insulator between heat sink and MOSFET.

(c) Remove insulating sleeve from gate and source lead of removed power MOSFET and install them on replacement power MOSFET.

(d) Position the appropriate insulator on heat sink where power MOSFET will be installed, ensuring lead and mounting holes are properly aligned.

NOTE

Ensure the insulator is the same type, and color where applicable, as the insulator originally installed. If a mica insulator, coated with thermal compound, is being used; ensure thermal compound is free of contaminants and mica insulator is not damaged.

(e) Set replacement power MOSFET's in the appropriate position on the heat sink, ensuring insulator is installed between the device and the heat sink.

(f) Position insulating spacers in the mounting holes of power MOSFET's mentioned in step (e) from the under side of the heat sink.

CAUTION

When replacing defective power MOSFET's ensure that the mounting holes and mounting surface are free from burrs or any sharp projection that could damage the insulating pads and/or plastic sleeves.

(g) Reinstall screws of power MOSFET's ensuring that screws with 'Belville' washers are torqued to five inch pounds (0.57 Newton meters or 0.58 kilogram meters).

(h) Resolder the appropriate leads to the source terminals of the power MOSFET's.

(i) Verify terminals of power MOSFET's, which protrude through the heat sink, are not shorting to the heat sink and the protective plastic sleeve over the gate leads of Q1 through Q10 and source terminals of Q1, Q2, Q4, Q6, Q8 and Q10 are present and not damaged.

(j) Verify the chassis is free from solder slivers and other conductive foreign objects, special attention will be paid to the holes in the heat sink containing power MOSFET terminals, the area around the insulated, conductive circuit board. See caution following paragraph 7.6 step (f).

(k) Ensure modulator power MOSFET's Q1 and Q2 have protective caps installed and the mounting straps for diode CR1 are securely fastened.

(l) Perform a resistance measurement as detailed in paragraph 7.5 to ensure replacement MOSFET's are serviceable.

(m) Resolder leads to gate terminals of power MOSFET's that have been replaced.

(n) Perform a visual inspection as outlined in paragraph 7.2.

7.7 TRANSFORMER(s) T1 and/or T2 REPLACEMENT: Replace defective rf drive transformers T1 and/or T2 using the wiring information shown in table 3 and illustrations in figure FO-9.

CAUTION

When reinstalling modulator printed circuit board A2, ensure thermistor A2RT1 is properly fitted and seated into the hole located on extruded, finned heat sink chassis directly below the printed circuit board (see figure FO-8).

7.8 REASSEMBLY OF NAA13 MODULATOR/POWER AMPLIFIER ASSEMBLIES (see figure FO-6): Reassemble PA assemblies as follows:

(a) Place the 1.25 kw power module on its side.

(b) Carefully slide the three PA assemblies (A1, A2 and A3) into their fabricated housing. Special care must be taken when reinstalling the PA assemblies to avoid damage to pot cores of low-pass filter inductors A3L1 thru A3L3 in each assembly.

(c) Replace the six attaching screws, two for each PA assemblies. Screws are located at either end of their respective PA assemblies.

CAUTION

Extreme care must be taken when reinstalling any of the six B- connecting screws (A1E1 thru A3E2) located on the -72 volt dc plate, the screws are easily stripped if excessive pressure is applied (figure FO-6).

(d) Replace the six 'B-' attaching screws A1E1 thru A3E2 on the -72 volt dc plate.

(e) Reconnect leads of transformer T1 to terminal board A1TB1-1 and A1TB1-2.

(f) Reconnect leads of transformer T2 to terminal board A2TB1-1 and A1TB1-2.

(g) Reconnect leads of transformer T3 to terminal board A3TB1-1 and A1TB1-2.

(h) Reconnect leads of fanning strip XA1TB2 to terminal board A1TB2-1,2,3,4,5,6.

(i) Reconnect leads of fanning strip XA2TB2 to terminal board A2TB2-1,2,3,4,5,6.

(j) Reconnect leads of fanning strip XA3TB2 to terminal board A3TB2-1,2,3,4,5,6.

(k) Carry out resistance measurement as tabulated in table 1.

(l) Perform a visual inspection as per paragraph 7.2.

Table 2 Wiring List - NAP10/1 1.25 kW AM Power Subsystem Module

SOURCE	DESTINATION	CODE		SIZE	REMARKS
XDS1-Anode	XDS1-Cathode	Resistor	RAP07	330 ohms	R1
XDS2-Anode	XDS2-Cathode	Resistor	RAP07	330 ohms	R2
XDS3-Anode	XDS3-Cathode	Resistor	RAP07	330 ohms	R3
XDS4-Anode	Ground near XDS4	Resistor	RJ03	4700 ohms	R5
TB1-1	J1-7	Resistor	RC05	2.2 ohms	R6
TB1-1	* L1-1, 2 or 3	-	White	20	
TB1-2	* L1-4, 3 or 2	-	White	20	
TB1-2	J1-4	-	Black	20	
TB1-3	J1-6	-	Black	20	
TB1-4	J1-9	-	White	20	
R4-4	C1(-)	-	White	2 x AWG 14	
J1-5	Ground near XDS4	-	Black	20	
J1-1	R4-1	-	White	14	
J1-2	R4-1	-	White	14	
J1-3	R4-1	-	White	14	
J1-8	XDS1-Anode	1	Red	20	
XA1TB2-4	XDS1-Cathode	2	Red	20	
XA2TB2-4	XDS2-Cathode	3	Red	20	
XA3TB2-4	XDS3-Cathode	4	Red	20	
XA1TB2-3	TP1	5	White	22	
XA2TB2-3	TP1	6	White	22	
XA3TB2-3	TP1	7	White	22	
R4-2	M1(-)	8	White	20	
R4-3	M1(+)	9	White	20	
TB1-4	XA1TB2-6	10	Core	RG188A/U	
TB1-3	XA1TB2-5	-	Shield		
TB1-4	XA2TB2-6	11	Core	RG188A/U	
TB1-3	XA2TB2-5	-	Shield		
TB1-4	XA3TB2-6	12	Core	RG188A/U	
TB1-3	XA3TB2-5	-	Shield		
TB1-1	XA1TB2-1	13	White	16	
TB1-2	XA1TB2-2	-	Shield		
TB1-1	XA2TB2-1	14	White	16	
TB1-2	XA2TB2-2	-	Shield		
TB1-1	XA3TB2-1	15	White	16	
TB1-2	XA3TB2-2	-	Shield		
R4-4	XDS4-Cathode	16	White	20	
T1-1	J2-1	Lead of T1			
T3-2	J2-4	Lead of T3			
T1-3/5/7	A1TB1-1	Leads of T1			
T1-4/6/8	A1TB1-2	Leads of T1			
T1-2	T2-1	Leads of T1/T2			
T2-3/5/7	A2TB1-1	Leads of T2			
T2-4/6/8	A2TB1-2	Leads of T2			
T2-2	T3-1	Leads of T2/T3			
T3-3/5/7	A3TB1-1	Leads of T3			
T3-4/6/8	A3TB1-2	Leads of T3			
XDS1-Anode	XDS2-Anode	Tinned Copper		22	
XDS2-Anode	XDS3-Anode	Tinned Copper		22	

* Denotes destination dependent on carrier frequency. Selected at final assembly.

Table 3 Wiring List - NAA13/2 Modulator/Power Amplifier Assembly

	SOURCE	DESTINATION	CODE		SIZE	REMARKS
*	Q11-Gate	Q11-Cathode	RAP09	Resistor	1000 Ohms	R1
A	Q11-Gate	Q11-Cathode	RAP09	Resistor	1000 Ohms	R1
A	Q11-Gate (+)	Q11-Cathode	CCP01	Capacitor	6.8 uF	C3
B, C	Q11-Gate (+)	Q11-Cathode	CCP01	Capacitor	6.8 uF	C3
	TB2-1	A1-5		White	16	1-Conductor
	TB2-2	A1-Ground	-	Shield	-	Shielded
	TB2-3	TT2 (R2)	-	White	22	
	TB2-4	A2-4	-	Red	22	
	TB2-5	A2-Ground	-	Black	22	
	TB2-6	A2-1	-	White	22	
	A2-2	Q11-Gate	-	White	22	
	A2-3	A1-1	-	White	22	
	A2-5	A1-2	-	White	22	
	A2-6	Q2-Source	-	White	22	
	A2-7	Q2-Gate	-	White	22	
	A2-8	Q1-Gate	-	White	22	
	A3L1	Q2-Case	-	White	14	
	A3L3	TT1	-	White	14	
	TT1	Q5-Source	-	White	16	
	TT1	Q9-Source	-	White	16	
	TT1	Q11-Cathode	-	White	16	
	T1-1	A1-3	-	Blue	-	Lead of T1
	T1-2	Ground	-	Blue	-	Lead of T1
	T1-3	A1-3	-	White	-	Lead of T1
	T1-4	Ground	-	White	-	Lead of T1
	T1-5	Q3-Source	-	Green	-	Lead of T1
	T1-6	Q3-Gate	-	Green	-	Lead of T1
	T1-7	Q4-Gate	-	Grey	-	Lead of T1
	T1-8	Q4-Source	-	Grey	-	Lead of T1
	T1-9	Q5-Gate	-	Violet	-	Lead of T1
	T1-10	Q5-Source	-	Violet	-	Lead of T1
	T1-11	Q6-Source	-	Black	-	Lead of T1
	T1-12	Q6-gate	-	Black	-	Lead of T1
	T2-1	A1-4	-	Blue	-	Lead of T2
	T2-2	Ground	-	Blue	-	Lead of T2
	T2-3	A1-4	-	White	-	Lead of T2
	T2-4	Ground	-	White	-	Lead of T2
	T2-5	Q7-Source	-	Green	-	Lead of T2
	T2-6	Q7-Gate	-	Green	-	Lead of T2
	T2-7	Q8-Gate	-	Grey	-	Lead of T2
	T2-8	Q8-Source	-	Grey	-	Lead of T2
	T2-9	Q9-Gate	-	Violet	-	Lead of T2
	T2-10	Q9-Source	-	Violet	-	Lead of T2
	T2-11	Q10-Source	-	Black	-	Lead of T2
	T2-12	Q10-Gate	-	Black	-	Lead of T2

* - Denotes used in NAA13/2 variation only
A - Denotes used in NAA13/2A variation only
B - Denotes used in NAA13/2B variation only
C - Denotes used in NAA13/2B variation only

Table 4 Ref Des Index - NAP10/1 1.25 kW AM Power Subsystem Module

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
*	-	AM Power Subsystem, 1.25kW	NAP10/01	149-1020-1	37338
A	-	AM Power Subsystem, 1.25kW	NAP10/01A	149-1020-2	37338
	A1	Modulator/Power Amplifier Assembly	NAA13/02	See Table 5	37338
	A2	Modulator/Power Amplifier Assembly	NAA13/02	See Table 5	37338
	A3	Modulator/Power Amplifier Assembly	NAA13/02	See Table 5	37338
	B1	Fan, 115V, 50/60Hz, Muffin XL	ZA06	MX2B3-028422	82877
	C1	Capacitor, Electrolytic, 18,000uF, 100V	CCD22	3188GH183T100BL	56699
	C2	Capacitor, Electrolytic, 18,000uF, 100V	CCD22	3188GH183T100BL	56699
	C3	Capacitor, Electrolytic, 18,000uF, 100V	CCD22	3188GH183T100BL	56699
	DS1	Diode, Light Emitting, Red	QK13	5082-4693	50434
	DS2	Diode, Light Emitting, Red	QK13	5082-4693	50434
	DS3	Diode, Light Emitting, Red	QK13	5082-4693	50434
	DS4	Diode, Light Emitting, Red	QK13	5082-4693	50434
	J1	Connector, 9 Pin-Contacts	149-1093-1	149-1093-1	37338
	J2	Connector, 2 Socket-Contacts	149-1091-1	149-1091-1	37338
	L1	Tuning Coil Assembly	149-1070	149-1070	37338
*	M1	Meter, M Series, 1 1/2" Square	MB04	OMS-DAA-040	32171
A	M1	Meter, 50 mV, 40A FSD	MB17	FC44P-X	00910
	R1	Resistor, Film, 330 ohms, 2% 1/2W	RAP07	RL20S331G	35005
	R2	Resistor, Film, 330 ohms, 2% 1/2W	RAP07	RL20S331G	35005
	R3	Resistor, Film, 330 ohms, 2% 1/2W	RAP07	RL20S331G	35005
	R4	Current Shunt	149-1065	149-1065	37338
	R5	Resistor, Comp, 4700 ohms, 5% 2W	RJ03	RC42GF472J	35005
	R6	Resistor, Film, 2.2 ohms, 2% 1/2W	RC05	A21-2.2 Ohms-2%	35005
	T1	Transformer	149-1030	149-1030	37338
	T2	Transformer	149-1030	149-1030	37338
	T3	Transformer	149-1030	149-1030	37338
	TB1	Terminal Block, Barrier, 4-terminal	JB03	4-140	71785
*	TP1	Jack, Tip, Violet, Teflon	J020	450-4355-1-0317	71279
A	TP1	Jack, Tip, White, Teflon	J021	450-4355-1-0319	71279
	XA1TB2	Fanning Strip, 6-pin, Right	JP39	6-161-R	71785
	XA2TB2	Fanning Strip, 6-pin, Right	JP39	6-161-R	71785
	XA3TB2	Fanning Strip, 6-pin, Right	JP39	6-161-R	71785
	XDS1	Socket, LED	QK25	PS-200-B	15513
	XDS2	Socket, LED	QK25	PS-200-B	15513
	XDS3	Socket, LED	QK25	PS-200-B	15513
	XDS4	Socket, LED	QK25	PS-200-B	15513

'Use Code' Explanation: * - Denotes used on NAP10/1 variation only

A - Denotes used on NAP10/1A variation only

Table 5 Ref Des Index - NAA13/2 Modulator/Power Amplifier Assembly

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
*	-	Modulator/Power Amplifier Assembly	NAA13/02	149-1000-2	37338
A	-	Modulator/Power Amplifier Assembly	NAA13/02A	149-1000-5	37338
B	-	Modulator/Power Amplifier Assembly	NAA13/02B	149-1000-6	37338
C	-	Modulator/Power Amplifier Assembly	NAA13/02C	149-1000-7	37338
*	A1	Current Imbalance Detector PCB Assembly	149-1044	149-1044	37338
A	A1	Current Imbalance Detector PCB Assembly	149-1044-1	149-1044-1	37338
B	A1	Current Imbalance Detector PCB Assembly	149-1044-1	149-1044-1	37338
C	A1	Current Imbalance Detector PCB Assembly	149-1044-1	149-1044-1	37338
	A1C1	Capacitor, Plastic, 0.0056uF 5%, 400V	CNP27	710P562X5400HK	56289
	A1C2	Capacitor, Plastic, 0.0056uF 5%, 400V	CNP27	710P562X5400HK	56289
	A1C3	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	A1CR1	Diode, General Purpose, Small Signal	QAP29	1N4938	01295
	A1Q1	Thyristor, Power	QB16	MCR203	04713
	A1R1	Resistor, Film, 6.8 ohms, 2% 1/2W	RC11	A20-6.8 Ohms-2%	36002
*	A1R2	Resistor, Film, 330 ohms, 2% 1/2W	RAP07	RL20S331G	35005
A	A1R2	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	35005
B	A1R2	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	35005
C	A1R2	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	35005
	A1T1	Toroid	LY09	11-122-B	33062
*	A2	Modulator PCB Assembly	149-1014	149-1014	37338
A	A2	Modulator PCB Assembly	149-1014-1	149-1014-1	37338
B	A2	Modulator PCB Assembly	149-1014-2	149-1014-2	37338
C	A2	Modulator PCB Assembly	149-1014-2	149-1014-2	37338
	A2C1	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
	A2C2	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
	A2CR1	Diode, General Purpose, Small Signal	QAP29	1N4938	01295
	A2CR2	Diode, Zener, 13V	QK31	1N5928B	04713
	A2CR3	Diode, Zener, 12.0V	QG08	1N759	04713
	A2Q1	Transistor, PNP	QAP09	2N2907	04713
	A2Q2	Transistor, PNP	QE38	MM5415	04713
	A2Q3	Transistor, PNP	QE38	MM5415	04713
	A2Q4	Transistor, NPN	QAP06	2N2222	04713
	A2Q5	Transistor, PNP	QAP09	2N2907	04713
*	A2R1	Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	35005
A	A2R1	Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	35005
B	A2R1	Resistor, Film, 22K ohms, 2% 1/2W	RD11	RL20S223G	35005
C	A2R1	Resistor, Film, 22K ohms, 2% 1/2W	RD11	RL20S223G	35005
	A2R2	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
	A2R3	Resistor, Film, 3300 ohns, 2% 1/2W	RAP11	RL20S332G	36002
	A2R4	Resistor, Film, 560 ohms, 2% 1/2W	RAP08	RL20S561G	36002
	A2R5	Resistor, Film, 560 ohms, 2% 1/2W	RAP08	RL20S561G	36002
	A2R6	Resistor, Comp, 6800 ohms, 5% 1W	RH05	RC32GF682J	36002
	A2R7	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
	A2R8	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
	A2R9	Resistor, Film, 10 ohms, 2% 1/2W	RAP01	RL20S100G	36002
	A2R10	Resistor, Film, 10 ohms, 2% 1/2W	RAP01	RL20S100G	36002
*	A2RT1	Thermistor, 100K ohms @ 25°C	RX03	GA51P2	73168
A	A2RT1	Thermistor, 100K ohms @ 25°C	RX03	GA51P2	73168
B	A2RT1	Thermistor, 100K ohms @ 25°C	RX06	AL03006-58.2K-97-G1	75263
C	A2RT1	Thermistor, 100K ohms @ 25°C	RX06	AL03006-58.2K-97-G1	75263

Table 5 Ref Des Index - NAA13/2 Modulator/Power Amplifier Assembly (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
	A3	Low-pass Filter PCB Assembly	149-1077-1	149-1077-1	37338
	A3C1	Capacitor, Plastic, 3.0uF 10%, 250V	CNP36	730P305X9250	56289
	A3C2	Capacitor, Plastic, 3.0uF 10%, 250V	CNP36	730P305X9250	56289
	A3C3	Capacitor, Plastic, 0.39uF 10%, 250V	CNP35	730P394X9250	56289
	A3C4	Capacitor, Plastic, 1.8uF 10%, 250V	CNP34	730P185X9250	56289
	A3C5	Capacitor, Plastic, 0.39uF 10%, 250V	CNP35	730P394X9250	56289
	A3L1	Inductor, 15.8uH	149-1061-3	149-1061-3	37338
	A3L2	Inductor, 12.6uH	149-1061-2	149-1061-2	37338
	A3L3	Inductor, 12.6uH	149-1061-2	149-1061-2	37338
	C1	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C2	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
*	C3	Not Used			
A	C3	Capacitor, Tantalum, 6.8uF 10%, 6V	CCP01	CSR13B685KM	56289
B	C3	Capacitor, Tantalum, 6.8uF 10%, 6V	CCP01	CSR13B685KM	56289
C	C3	Capacitor, Tantalum, 6.8uF 10%, 6V	CCP01	CSR13B685KM	56289
	C4	Not Used			
	C5	Not Used			
	C6	Not Used			
	C7	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C8	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C9	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C10	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C11	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C12	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C13	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
	C14	Capacitor, Plastic, 0.22uF 10%, 250V	CS07	52003224K	37903
*	CR1	Diode, Schottky Rectifier, 60A, 100V	QL15	60 HQ 100	81483
A	CR1	Diode, Power Rectifier, 50A, Ultra Fast	QL11	MUR5020	04713
B	CR1	Diode, Power Rectifier, 50A, Ultra Fast	QL11	MUR5020	04713
C	CR1	Diode, Power Rectifier, 50A, Ultra Fast	QL11	MUR5020	04713
*	CR2	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR2	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR2	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR2	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
*	CR3	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR3	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR3	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR3	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
*	CR4	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR4	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR4	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR4	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
*	CR5	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR5	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR5	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR5	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
*	CR6	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR6	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR6	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR6	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713

Table 5 Ref Des Index - NAA13/2 Modulator/Power Amplifier Assembly (Continued)

USE CODE	REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN/MIL/OEM PART NO.	OEM CODE
*	CR7	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR7	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR7	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR7	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
*	CR8	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR8	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR8	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR8	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
*	CR9	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR9	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR9	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR9	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
*	CR10	Diode, Schottky Rectifier, 4A	QL10	50 SQ 100	81483
A	CR10	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
B	CR10	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
C	CR10	Diode, Power Rectifier, 4A, Ultra Fast	QI10	MUR415	04713
	Q1	Transistor, Field Effect, N Channel	QAP26	IRF130 Generation 3	81483
	Q2	Transistor, Field Effect, N Channel	QAP26	IRF130 Generation 3	81483
	Q3	Transistor, Field Effect, N Channel	QAP41	IRF140 Generation 3	81483
	Q4	Transistor, Field Effect, N Channel	QAP41	IRF140 Generation 3	81483
	Q5	Transistor, Field Effect, N Channel	QAP41	IRF140 Generation 3	81483
	Q6	Transistor, Field Effect, N Channel	QAP41	IRF140 Generation 3	81483
	Q7	Transistor, Field Effect, N Channel	QAP41	IRF140 Generation 3	81483
	Q8	Transistor, Field Effect, N Channel	QAP41	IRF140 Generation 3	81483
	Q9	Transistor, Field Effect, N Channel	QAP41	IRF140 Generation 3	81483
	Q10	Transistor, Field Effect, N Channel	QAP41	IRF140 Generation 3	81483
*	Q11	Thyristor, Power	QB18	C231A	04713
A	Q11	Thyristor, Power	QB18	C231A	04713
B	Q11	Thyristor, Power	QB18	C231A	04713
C	Q11	Thyristor, Power	QB36	MCR 231A	04713
*	R1	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A	R1	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
B	R1	Not Used			
C	R1	Not Used			
	R2	Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	36002
	T1	Transformer	149-1060	149-1060	37338
	T2	Transformer	149-1060-1	149-1060-1	37338
	TB1	Terminal Block, Barrier, 2-terminal	JP12	GFTSA-2	73631
	TB2	Terminal Block, Barrier, 6-terminal	JP38	GFT-6	73631

For complete reference designation, prefix with reference designation assigned at next higher assembly (A1, A2, A3) and with reference designations of all higher assemblies.

'Use Code' Explanation:
* - Denotes used on NAA13/02 variation only
A - Denotes used on NAA13/02A variation only
B - Denotes used on NAA13/02B variation only
C - Denotes used on NAA13/02C variation only

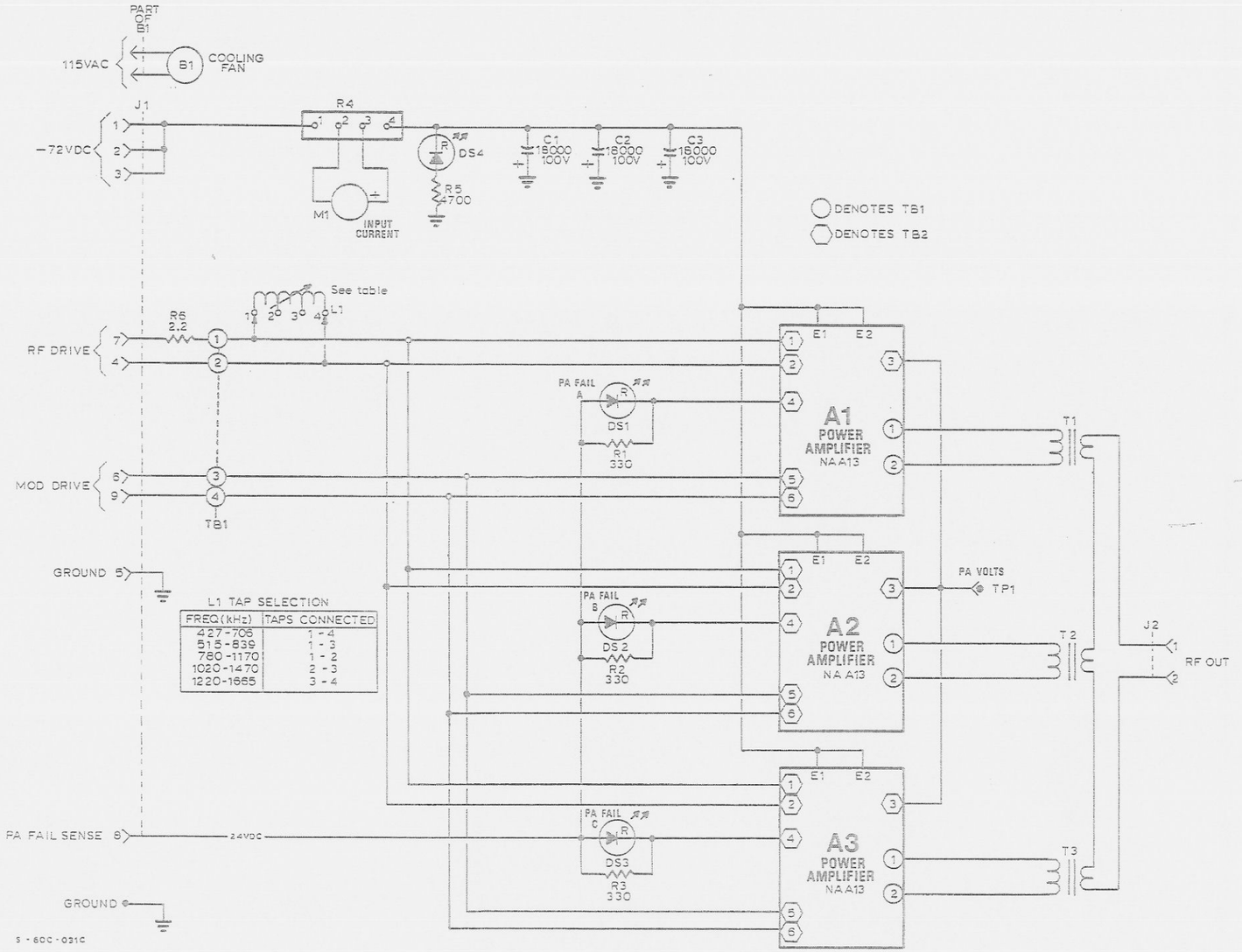
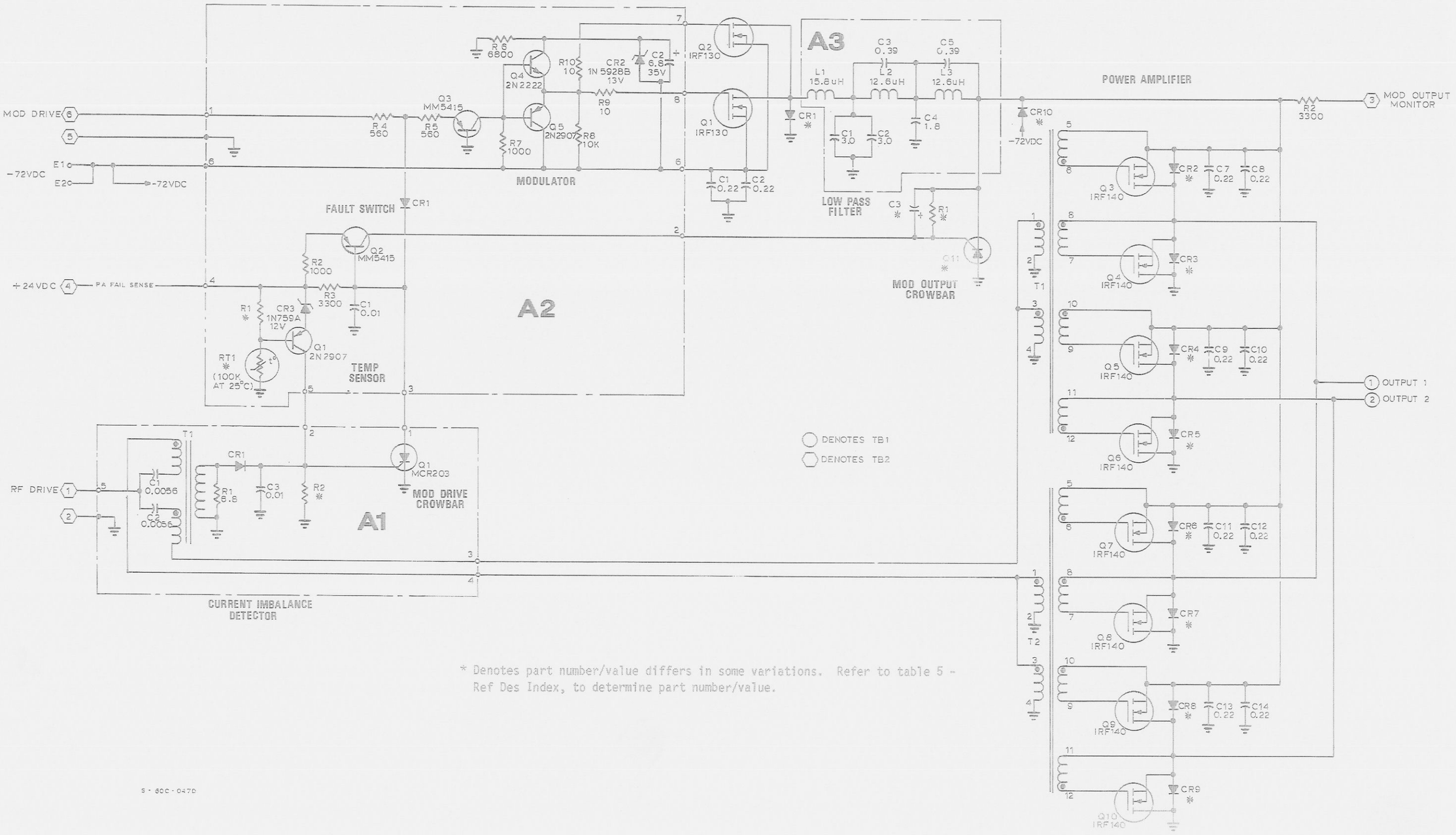


Figure FO-1 Electrical Schematic - NAP10/1 1.25 kW AM Power Subsystem Module



* Denotes part number/value differs in some variations. Refer to table 5 - Ref Des Index, to determine part number/value.

S-60C-047D

Figure FO-2 Electrical Schematic - NAA13/2 Modulator/Power Amplifier Assembly

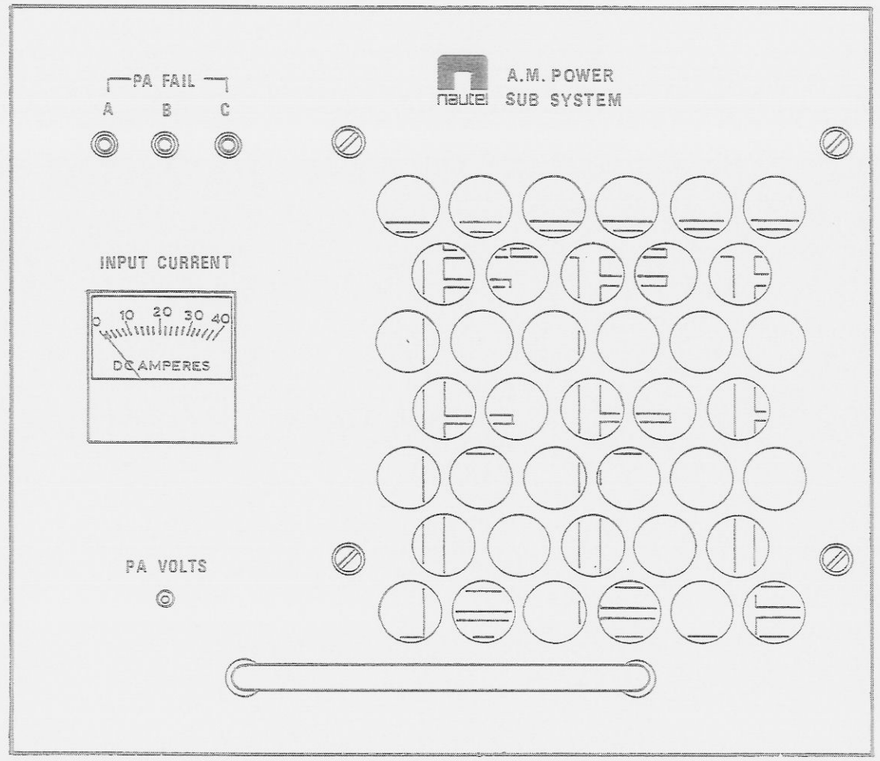


Figure FO-3 Assembly Detail - NAP10/1 1.25 kW AM Power Subsystem Module (Front View)

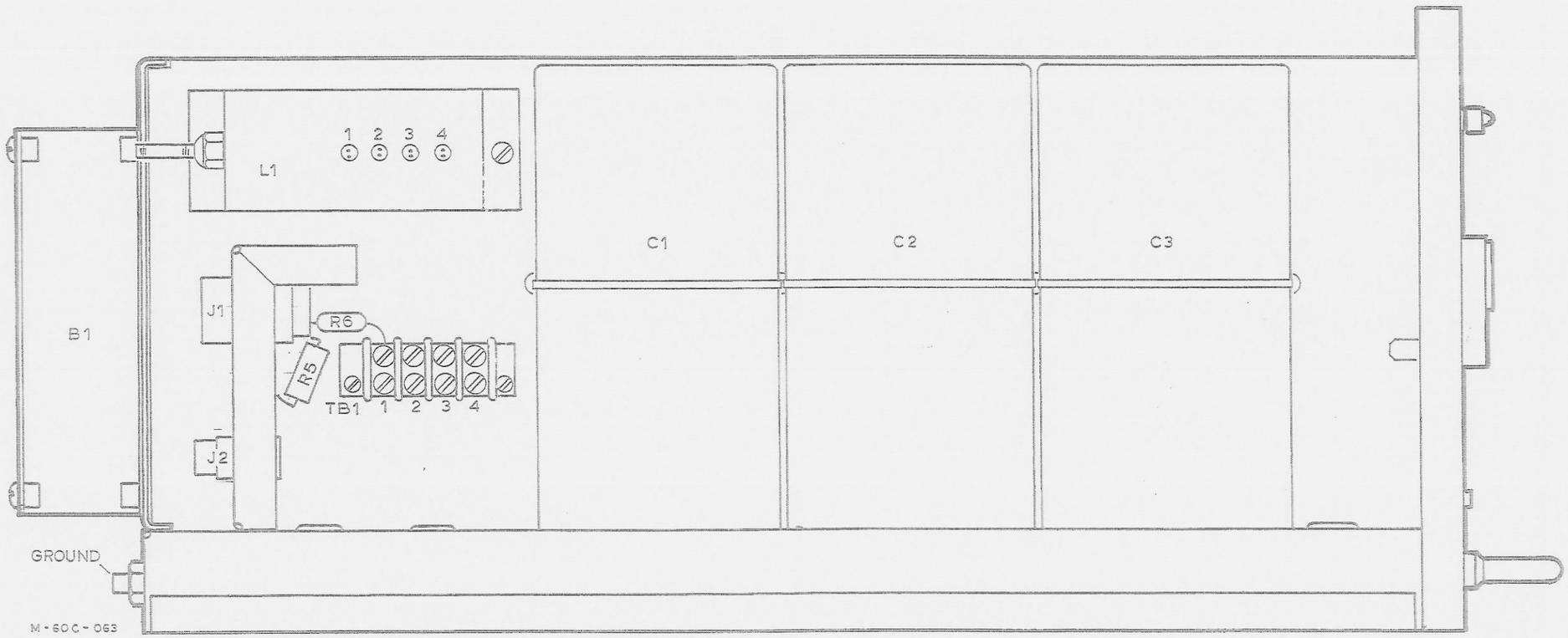


Figure FO-4 Assembly Detail - NAP10/1 1.25 kW AM Power Subsystem Module (Side View)

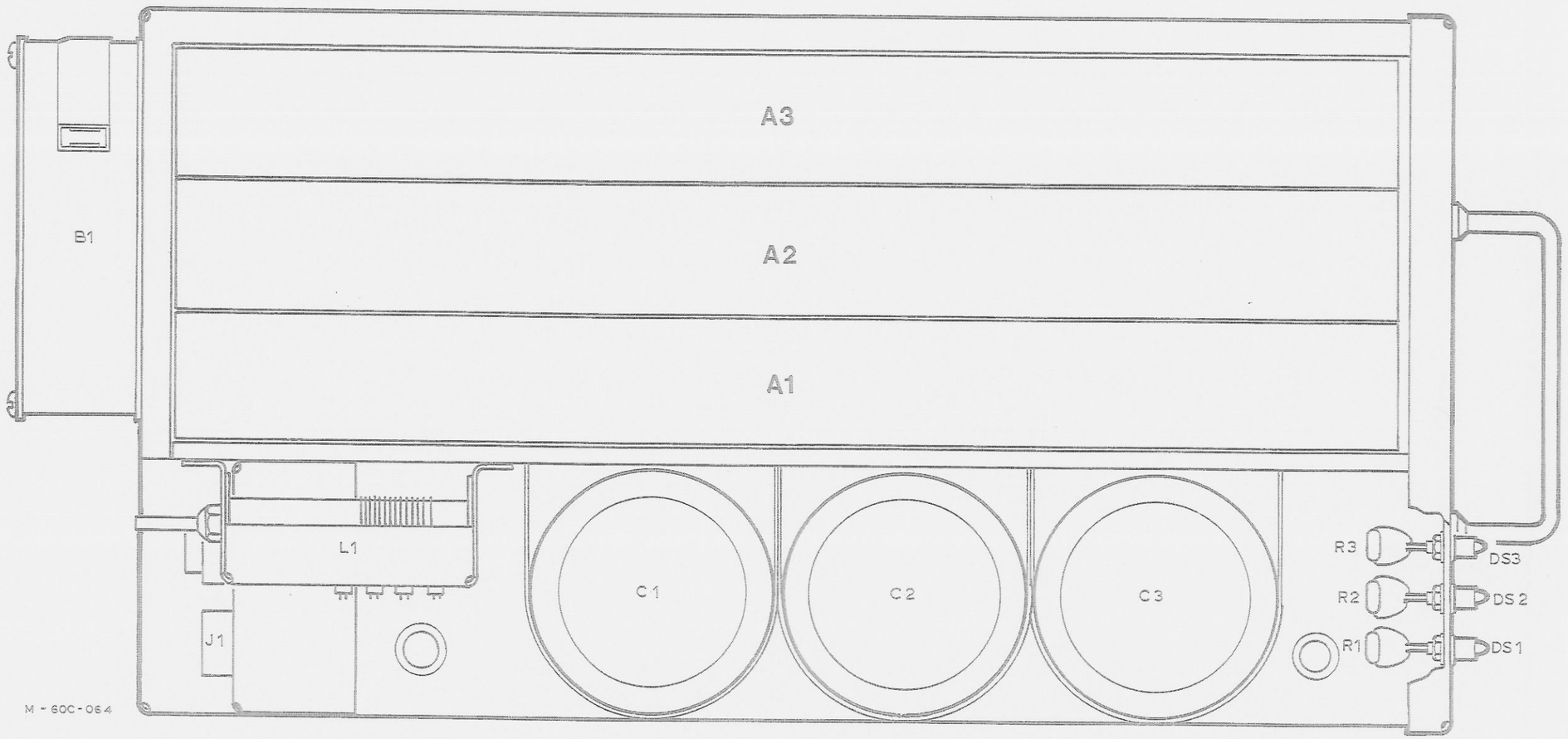


Figure FO-5 Assembly Detail - NAP10/1 1.25 kW AM Power Subsystem Module (Top View)

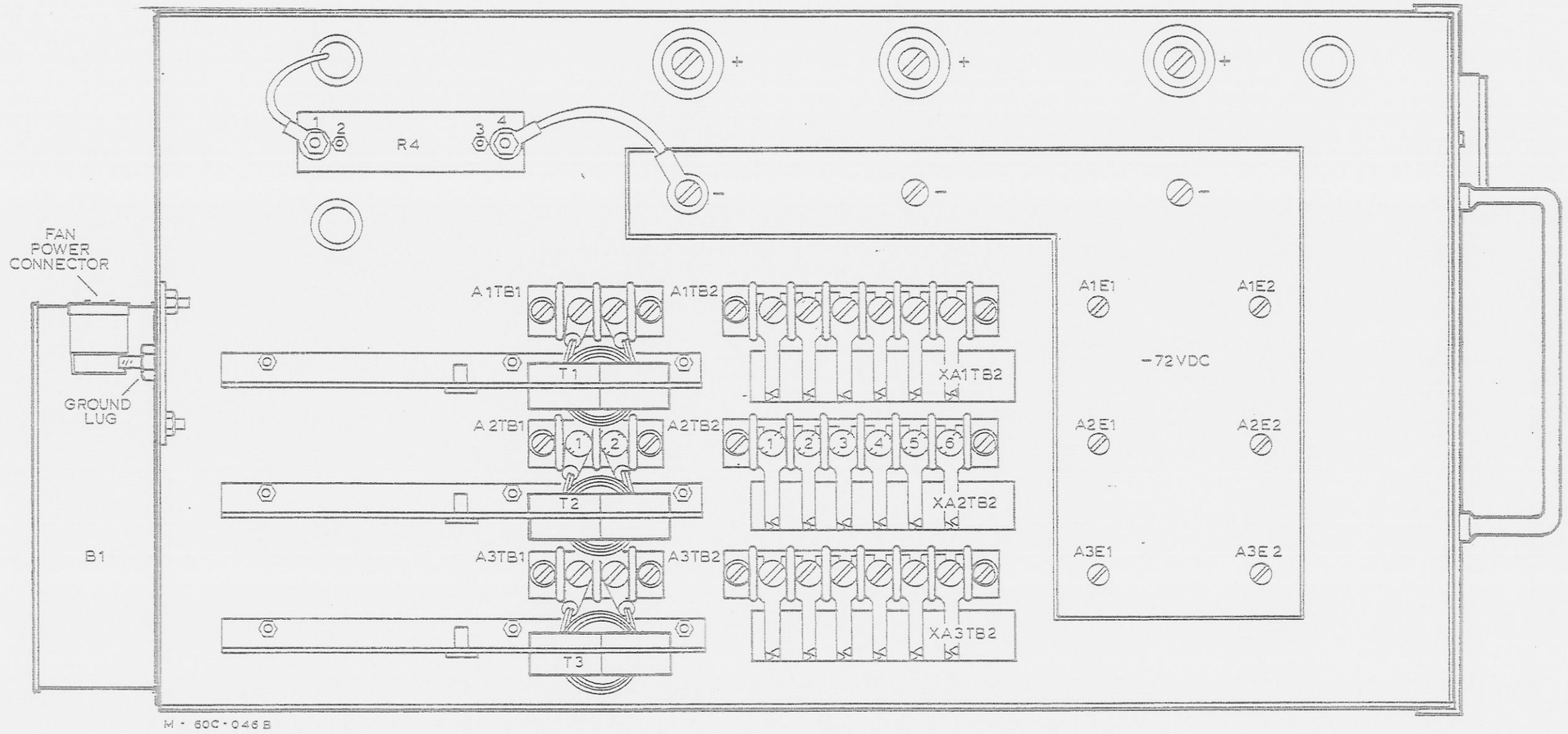


Figure FO-6 Assembly Detail - NAP10/1 1.25 kW AM Power Subsystem Module (Bottom View)

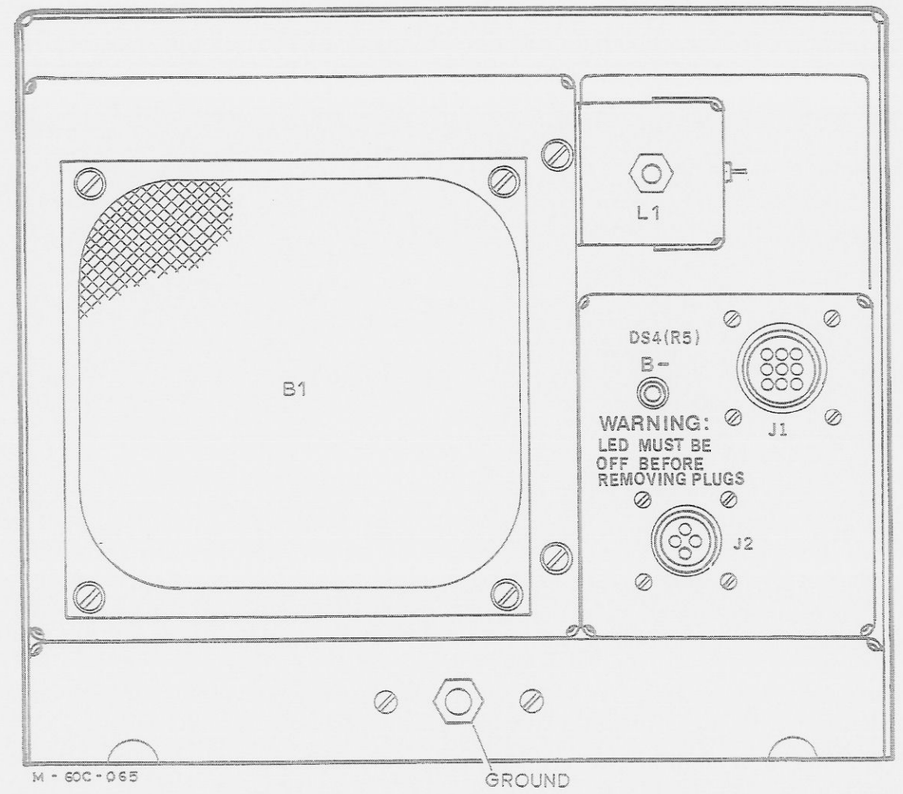


Figure FO-7 Assembly Detail - NAP10/1 1.25 kW AM Power Subsystem Module (Rear View)

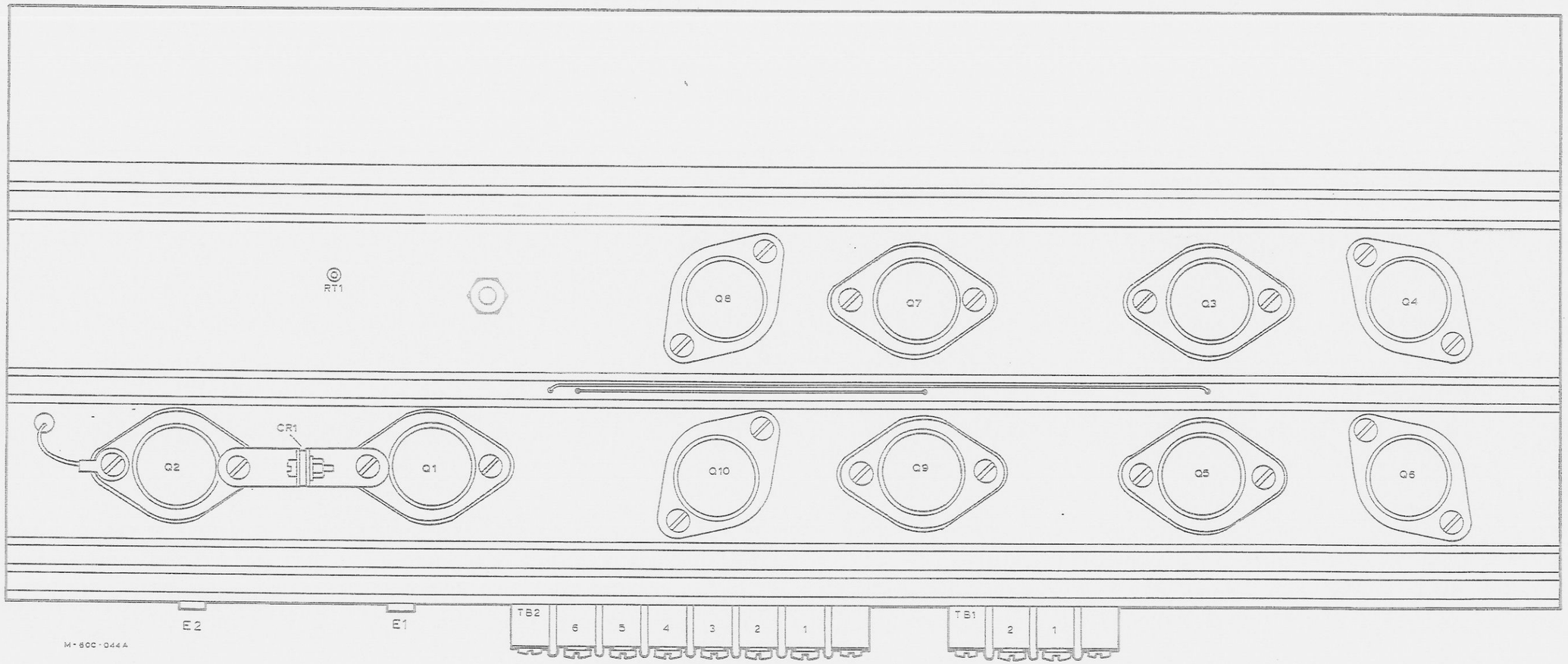


Figure FO-8 Assembly Detail - NAA13/2 Modulator/Power Amplifier Assembly (Side 1)

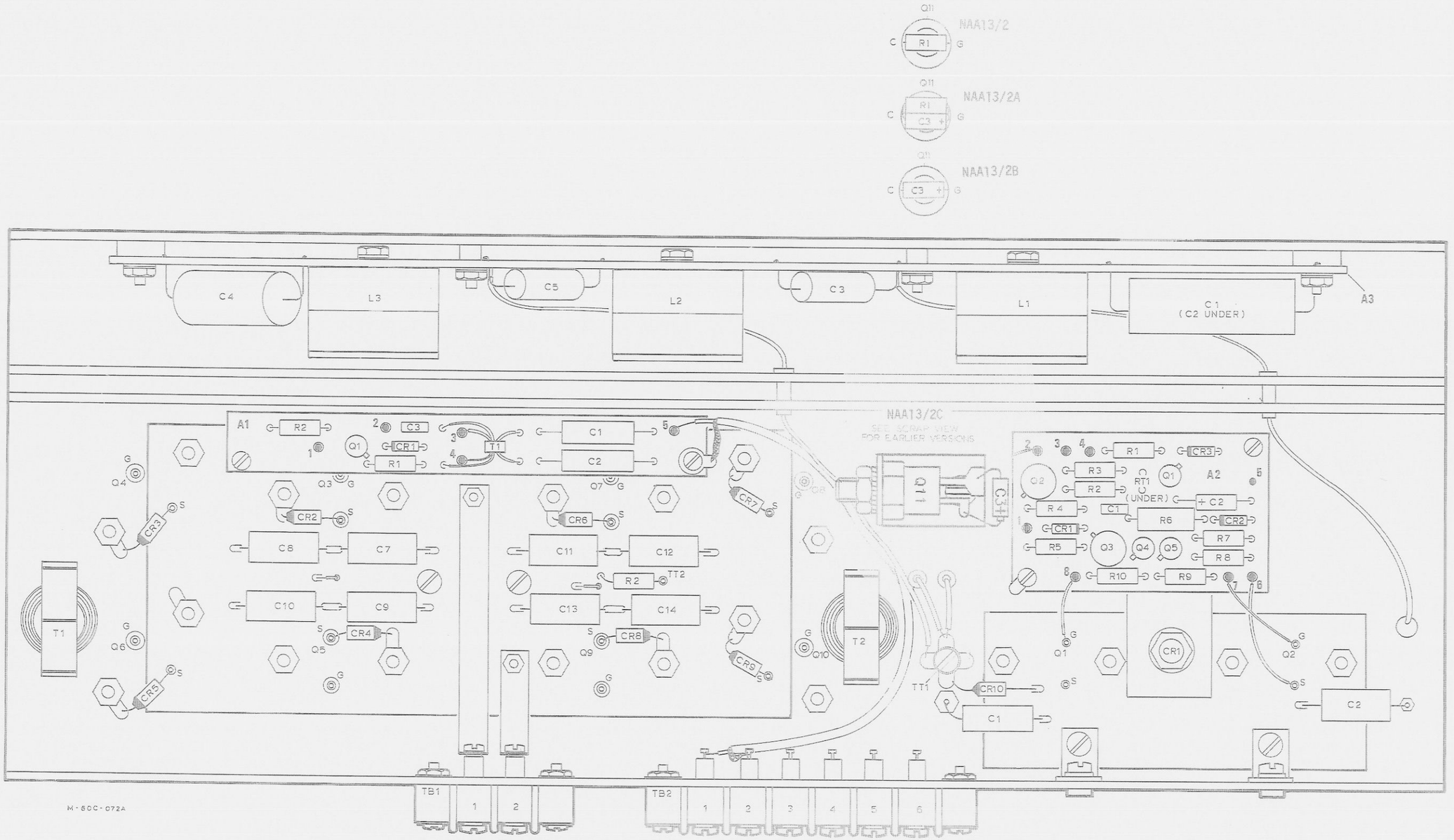


Figure FO-9 Assembly Detail - NAA13/2 Modulator/Power Amplifier Assembly (Side 2)