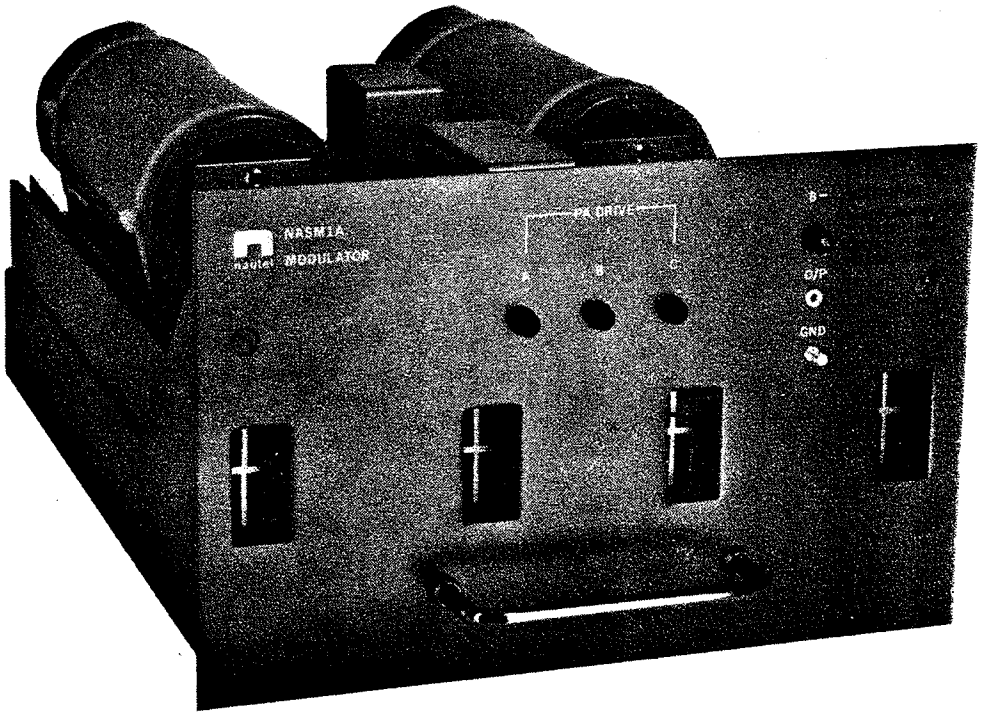
SERVICE INSTRUCTION

NASM1A

MODULATOR MODULE



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LIST OF EFFECTIVE PAGES

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Original . . . . 15 October 1983

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INTRODUCTION

1. The NASM1A modulator module contains circuitry which accepts the constant amplitude, 70 kHz, positive logic, variable width pulses from its associated modulator driver and provides a a modulated negative dc voltage to a block of six power amplifiers as their -DC operating voltage. Each block of six power amplifiers can produce up to 1.25 kilowatts of rf carrier power. The modulator module, in conjunction with its associated modulator driver module may be considered an audio amplifier with a fixed dc offset corresponding to its output carrier level. Trouble shooting and repair of the module is performed on a work bench independent of it's associated transmitter. This document provides the information required for a competent technician to understand the operation of the electrical circuits and the procedures to restore defective modules to a serviceable status; using tools and test equipment normally available at an AM radio station workshop. An alternative to procedures provided in this document is to utilize Nautel's module exchange/repair service facilities.

FACTORY EXCHANGE/REPAIR SERVICE

2. 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 NASM1A monitor module utilizes a formed, metal box as the module chassis. Two switched regulator extrusion assemblies (A1 and A2), two capacitors, three relays and a power diode are mounted on the top side of the chassis (see figure 5). A modulator printed circuit board assembly (A3), an imbalance detector assembly (A4), a transformer assembly (A5), four inductors, two fuses and two resistors are mounted on the bottom side of the chassis (see figure 6). Two electrical connectors are installed on the rear of the chassis and a stamped panel containing a handle, three lamps, a test jack, a ground terminal and four air flow slots, is installed on the front (see figure 4). Interconnecting wiring from the connectors and fuses is connected by soldering to standoff terminals on the appropriate assembly or directly to terminals on the relay sockets. High current carrying wires are terminated by solder lugs and are mechanically secured at their destination by nuts on threaded terminals.

3.1 SWITCHED REGULATOR EXTRUSION ASSEMBLY (See figure 7): Switched regulator extrusion assembly (A1 and A2) utilize an extruded, finned, heat sink as their chassis. The heat dissipating components and a large energy storage capacitor are mounted directly on the heat sink. The remaining components are mounted on a printed circuit board assembly which is fastened to the heat sink by standoff pillars.

3.2 MODULATOR PRINTED CIRCUIT BOARD ASSEMBLY: Modulator printed circuit board assembly A3's components are soldered to its printed wiring pattern. External wiring is connected by soldering to standoff terminals. Refer to figure 6 for assembly detail.

3.3 IMBALANCE DETECTOR ASSEMBLY: Imbalance detector assembly A4 utilizes standoff terminals for the interconnection of its electrical components. The high current carrying leads are terminated by solder lugs and are mechanically secured by nuts on threaded terminals. External, high current carrying wiring is connected using solder lugs on the threaded terminals while low current carrying wires are soldered to standoff terminals. Refer to figure 6 for assembly detail.

3.4 TRANSFORMER ASSEMBLY: Transformer assembly A5 contains an adjustable transformer and two capacitors. The primary leads of the transformer are terminated by solder lugs for mechanical connection at their destination using nuts on threaded terminals. The secondary leads and the capacitors are soldered to standoff terminals.

THEORY OF OPERATION

4. The NASM1A modulator module accepts constant amplitude, 70 kHz, positive logic, variable width pulses from its associated modulator driver and provides a modulated, negative dc voltage to six power amplifiers. It also monitors the status of the six power amplifiers (in pairs) and removes the modulator output from any pair of power amplifiers that are faulty. Refer to figure 3 for the electrical schematic.

4.1 MODULATOR INHIBIT CIRCUIT: Transistor A3Q1 and its associated components form a circuit that inhibits the modulator drive and therefore the output of the modulator until the -72 volt dc power supply voltage is more negative than -63 volts dc. The -72 volt dc current source is provided thru P2-9/10/11/12 (-72 volts dc), by the modulator's associated rectifier/regulator module. During initial turn-on storage capacitors A1C1 and A2C1 will be discharged and there will be an exponential delay before -72 volts dc is obtained, while A1C1 and A2C1 are charging. When the transmitter or the modulator's associated rectifier/regulator is turned off, A1C1 and A2C1 discharge thru R1 and R2. When the transmitter is returned to its on status, there may be a delay before the modulator will produce an output while the storage capacitors are charging to a voltage that is more negative than -63 volts dc. The negative voltage (-72 volts dc) at the junction of R1/C1 is applied to P1-3 and one end of voltage divider Voltage divider A3R6/R7. 15 volts dc applied to the other end of the voltage divider. The voltage applied to P1-3 is not used on all AMPFET transmitters. It is used as the MOD I/P VOLTS source voltage for the TEST meter on AMPFET 1 transmitters.

4.1.1 When the negative voltage on voltage divider A3R6/R7 is less than -63 volts dc, the voltage at the junction of A3R6/R7 will be sufficiently positive to forward bias the base/emitter junction of transistor A3Q1. A3Q1 will turn on and a apply a 'logic 0' (ground) to A3U1A-2 and A3U1D-12. Gates A3U1A and A3U1D will be inhibited and their outputs will be held at a 'logic 0', inhibiting the 'modulator drive' signal.

4.1.2 When the negative voltage on voltage divider A3R6/R7 exceeds -63 volts dc, the voltage at the junction of A3R6/R7 will be negative and the base/emitter junction of transistor A3Q1 will be reverse biased. A3Q1 will turn off and apply a 'logic 1' (15 volts dc) to A3U1A-2 and A3U1D-12. Gates A3U1A and A3U1D will be enabled and their outputs will follow the 'modulator drive' signal applied to their other input gates from P1-6.

4.2 SWITCHED REGULATOR CIRCUIT: The switched regulator circuit changes the logic level of the variable width 'modulator drive' pulses from a ground reference for 'logic 0' to a -72 volts dc reference for 'logic 0'. Gate A3U1A, transistor A3Q2, A3Q2's associated components and the components on switched regulator assembly A1 form a parallel and identical circuit with gate A3U1D, transistor A3Q3, A3Q3's associated components and the components on switched regulator assembly A2. The following circuit description is applicable to both circuits:

4.2.1 The 'modulator drive' pulses, from P1-6, are passed thru A3U1A; when it is enabled by a 'logic 1' signal from A3Q1, and are applied to the base of A3Q2. A3Q2 will be forward biased (turned on) when the input pulses to its base are a 'logic 1'. Current (approximately 13 milliamps) will flow from 15 volts dc, thru A3Q2, A3R8, A1A1R1 and the emitter of A1A1Q1. A1A1Q1 will be forward biased (turned on) and current (13 milliamps) will flow thru A1A1Q1 and A1A1R2 to -72 volts dc. Approximately 13 volts dc will be dropped across A1A1R2, therefore, the voltage applied to the base of A1A1Q2 and A1A1Q3 will be reduced to -59 volts

dc ('logic 1'). When the pulses applied to the base of transistor A3Q2 go to a 'logic 0', A3Q2 will be reverse biased (turned off) and current will not flow thru A3Q2. A1A1Q1 will be reverse biased (turned off), current will not flow thru A1A1R2 and the voltage applied to the base of A1A1Q2 and A1A1Q3 will be switched to -72 volts dc ('logic 0').

4.2.2 Zener diode A1CR1 maintains the voltage on the collector of A1A1Q2 at -59 volts dc, regardless of the state of A1A1Q2; to ensure the voltage across the gate/source junction of power MOSFET's A1Q1 thru A1Q4 does not exceed 13 volts dc. Transistors A1A1Q2 and A1A1Q3 act as switches between -59 volts dc and -72 volts dc to charge and discharge the capacitive load presented by the gates of power MOSFET's A1Q1 thru A1Q4. When the gates of A1Q1 thru A1Q4 are charged to -72 volts dc and a 'logic 1' (-59 volts dc) is applied to the base of A1A1Q2 and A1A1Q3, A1A1Q2 will be forward biased (turned on) and A1A1Q3 will be reverse biased (turned off). The the gates of A1Q1 thru A1Q4 will discharge to -59 volts dc and forward bias (turn on) A1Q1 thru A1Q4. When a 'logic 0' (-72 volts dc) is applied to the base of A1A1Q2 and A1A1Q3, A1A1Q2 will be reverse biased (turned off) and A1A1Q3 will be forward biased (turned on). The gates of A1Q1 thru A1Q4 will charge to -72 volts dc and reverse bias (turn off) power MOSFET's A1Q1 thru A1Q4. Power MOSFET's A1Q1 thru A1Q4 act as switches that connect their load to -72 volts dc when they are switched on and connect their load to ground when they are switched off. Diode A1CR3 is a free wheeling diode that prevents the voltage on the drain junction of A1Q1 thru A1Q4 from going positive.

4.3 MODULATOR OUTPUT: When A1Q1 thru A1Q4 are switched on, current pulses, with the same duration as the variable width 'modulator drive' pulses applied to P1-6, are applied thru inductor L1 and one half of relay A4K1's coil. Power MOSFET's A2Q1 thru A2Q4 will turn on simultaneously and their current pulses will flow thru L2 and the other half of A4K1's coil. The two current pulses are summed at the centre tap of A4K1's coil and are applied to low pass filter C1, L3/L4 and C2. The low pass filter, in conjunction with 70 KHz notch filter A5T1/C1/C2; has a flat frequency response from zero to 10 kHz ($\pm$ 0.5 dB), rolling off -2 dB at 15 kHz and a nominal -60 dB notch at the switching frequency of 70 kHz. The output of the filter is a negative dc voltage that varies at the frequency and amplitude of the modulating audio being applied to the associated modulator driver module. The level of the negative voltage is the average of the fixed width pulses (from the modulator driver module) required to produce the desired rf carrier output from the transmitter when their is no modulation present. The superimposed audio's frequency is determined by the rate the pulse width changes and its amplitude is determined by the amount the pulse width differs from the fixed width of the reference pulses. The 'modulator output' on P1-7 is not used on all AMPFET transmitters. It is used as the MOD O/P VOLTS source voltage for the TEST meter on AMPFET 1 transmitters.

4.3.1 The filtered, negative dc voltage with superimposed audio, is applied to the normally closed contacts of relays K1 thru K3 and to P1-7 as the 'modulator output'. The wipers of each relay are connected, in parallel, to a pair of the six power amplifier modules associated with the modulator. K1-9 is connected thru P2-4 to one power amplifier of pair 'A' and K1-12 is connected thru P2-3 to the second power amplifier. K2-9 is connected thru P2-6 to one power amplifier of pair 'B' and K2-12 is connected thru P2-5 to the second power amplifier. K3-9 is connected thru P2-8 to one power amplifier of pair 'C' and K3-12 is connected thru P2-7 to the second power amplifier.

4.3.2 B- Lamp DS1 will turn on at full brilliance when -72 volt dc is being applied to P2-9/10/11/12 and storage capacitors A1C1/A2C1 are fully charged. When the transmitter or the rectifier/regulator module associated with the modulator is turned off, the brilliance of the lamp will slowly decay as A1C1 and A2C1 discharge thru R1 and R2. Diode CR1 ensures the voltage at the junction of L3/L4 and C2 does not go more negative than -72 volts dc.

4.4 IMBALANCE DETECTOR CIRCUIT: The imbalance detector circuit; which consists of relay A4K1, thyristor A4Q1, A4Q1's associated components and relays K1 thru K3; isolates the modulator from its load when a component failure occurs within the modulator in order to avoid further damage to the modulator. When there is a significant difference (more than 7 amperes) in the current flow thru each half of relay A4K1's coil, A4K1 will energize and apply 15 volts dc to voltage divider A4R1/R2. The positive voltage at the junction of A4R1/R2 will forward bias thyristor A4Q1 and turn it on. When A4Q1 is turned on, relays K1 thru K3 will energize, remove the 'A, B and C outputs' of the modulator and connect a ground as the output to the associated power amplifiers. The six power amplifiers associated with the modulator will effectively be turned off. A4Q1 will remain on and the relays will be energized until the transmitter is switched off and then on.

4.4.1 24 volts dc for the coils of relays K1 thru K3's is provided thru P1-4 and fuse F1 from the power amplifier failure circuit in the associated transmitter's monitor module. When one or more relays energize, the initial current surge will cause the monitor module to inhibit the 'modulator drive' from the modulator driver module and effectively turn off the modulator's output immediately prior to and during the relay contact break/make transition period. This feature protects the relay contacts from damage by ensuring current is not flowing during the contact transition period.

4.5 POWER AMPLIFIER FAILURE PROTECTION: Power amplifier failure protection is provided by removing the -DC voltage ('A, B or C output') to the applicable pair of power amplifiers when a failure has been detected by their associated power amplifier fault detector. When a power amplifier failure has been detected, a 'shutdown' command is applied to P1-10 (pair A), P1-9 (pair B) or P1-5 (pair C). If an 'A shutdown' command is applied to P1-10, indicating a failure in one of pair A's power amplifiers; 15 volts dc is applied thru P1-10 and A3R2 to the gate of thyristor A3Q4. A3Q4 will turn on and energize relay K1. When relay K1 is energized, the modulator output is removed from and a ground is applied to P2-4 and P2-5. Both power amplifiers of pair A will be effectively turned off. A3Q4 will remain on until the transmitter is turned off and then turned on. The circuits that protect the B and C 'outputs' are identical to the circuit described for the 'A output'. Relay contact protection, during the make/break transistion period, is the same as that described in paragraph 4.4.1.

TROUBLESHOOTING

5. Troubleshooting of modulator modules that are defective or are suspected of being defective consists of performing a visual inspection and then conducting a functional test to isolate the defective components.

5.1 TEST EQUIPMENT AND SPECIAL TOOLS: The test equipment required is listed in table 1. There are no special tools required.

5.2 VISUAL INSPECTION: It is recommended that a visual inspection be performed on the modulator module prior to applying power. Inspect the module for the following:

(a) Inspect all electrical components for evidence of overheating or physical damage.

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

(c) Verify connectors P1 and P2 do not contain damaged or loose pins and that they are securely fastened to the chassis.

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

(e) Verify wire strands of wiring conductors are not broken or otherwise damaged.

(f) Verify the chassis, assemblies and printed circuit board are free from solder slivers and other conductive foreign objects.

(g) Verify fuses F1 and F2 are the correct value and are not defective.

(h) Verify storage capacitors A1C1 and A2C1 are securely fastened to their extrusion by two tywraps.

(i) Verify integrated circuit device A3U1 is installed and firmly seated in its socket.

(j) Verify relays K1 thru K3 are installed and firmly seated in their sockets.

(k) Verify cores of inductors L1, L2, L3 and L4 are not cracked. Chipping on edges of cores may be ignored.

(l) Verify all fastening hardware is securely tightened.

5.3 FUNCTIONAL TEST: Functional testing of the modulator module is the recommended first step in troubleshooting a defective module and also verifies the module is operating within design limits after corrective action has been taken. Modules that meet the requirements of the functional test may be considered to be operating satisfactorily and returned to service.

NOTE

Final testing of the modulator module is performed with the module installed in the transmitter it will be used in. Instructions are provided in the associated transmitter's instruction manual.

5.3.1 Preparation for Test: Prepare the modulator module for test as follows:

CAUTION

Do not permit conductive tools or materials to come in contact with negative voltage points when the B- lamp is on. When fully charged, storage capacitors A1C1 and A2C1 contain sufficient energy to produce a dangerous low voltage-high current arc. The danger involved is not an electrical shock but rather the light flash and welding potential of this arc. Even at -24 volts, the energy stored in capacitors A1C1 and A2C1 is sufficient to cause serious arcing if these capacitors are accidentally shorted to ground. A period of up to five minutes may be required for the storage capacitors to fully discharge. A discharge probe similar to the one mounted on the associated transmitter may be used to discharge the storage capacitors more quickly.

(a) Verify the visual inspection has been completed.

(b) Connect the NASM1A modulator and a serviceable NAPE19 modulator driver module to the test setup depicted in figure 1.

NOTE

The following test procedure uses -24 volts dc instead of -72 volts dc as the negative voltage for the modulator. It is necessary to change the values of A3R7, A1A1R3 and A2A1R3 for operation at -24 volts dc. The temporary circuit alterations of steps (c) thru ( ) are required.

(c) Connect an 18K ohm resistor in parallel with (across) A3R7.

(d) Connect an 1000 ohm resistor in parallel with (across) A1A1R3.

(e) Connect an 1000 ohm resistor in parallel with (across) A2A1R3.

(f) Connect an oscilloscope between terminal B of printed circuit board A3 and chassis ground.

(g) Switch on test setup's 15 volt dc power supply and set its output to 14.3 volts dc.

(h) Oscilloscope waveform should be fixed width, 70 kHz, 'logic 1' (15 volt dc), 'modulator drive' pulses from the modulator driver module (see figure 2 for typical waveform).

(i) Adjust HIGH CARR LEVEL potentiometer of modulator driver module for fixed 'logic 1' (15 volts dc) pulses of 1.4 microseconds duration (10% duty cycle).

NOTE

Higher duty cycles will draw excessive current from the -24 volt power supply.

5.3.2 Test of Power Amplifier and Modulator Protection Circuits: Check the power amplifier and modulator protection circuits as follows:

(a) Disconnect the test setup connector connected to P2 of the modulator.

(b) Connect a 24 volt dc power supply that has been preset to 24.0 volts dc between test setup's +24 VDC (+) test jack and GND (-) test jack.

(c) Modulator's 'A' (DS2), 'B' (DS3) and 'C' (DS4) lamps shall be off.

(d) Sequentially measure continuity between the lead of A5T1, connected to relays K1 thru K3 and P2-3, P2-4, P2-5, P2-6, P2-7 and P2-8.

(e) Each measurement obtained in step (c) should be a short circuit (zero ohms).

(f) Momentarily connect +15 volts dc to junction of A4K1 and A1R1.

(g) Modulator's 'A' (DS2), 'B' (DS3) and 'C' (DS4) lamps shall turn on and remain on.

(h) Sequentially measure continuity between chassis ground and P2-3, P2-4, P2-5, P2-6, P2-7 and P2-8.

(i) Each measurement obtained in step (g) should be a short circuit (zero ohms).

(j) Switch 24 volt dc power supply off and then switch it on.

(k) Modulator's 'A', 'B' and 'C' lamps shall turn off and remain off.

(l) Momentarily close test setup's PA 'A' FAIL switch.

(m) Modulator's 'A' lamp (DS2) shall turn on and remain on.

(n) Momentarily close test setup's PA 'B' FAIL switch.

(o) Modulator's 'B' lamp (DS3) shall turn on and remain on.

(p) Momentarily close test setup's PA 'C' FAIL switch.

(q) Modulator's 'C' lamp (DS4) shall turn on and remain on.

(r) Switch 24 volt dc power supply off and disconnect it from test setup's +24 VDC and GND test jacks.

(s) Disconnect digital voltmeter.

5.3.3 Test of Logic Circuits: Test the logic circuits as follows:

(a) Connect a 24 volt dc power supply that has been preset to zero volts dc between test setup's -DCV (-) test jack and GND (+) test jack.

(b) Connect an oscilloscope between terminal B of dc offset assembly A1A1 and chassis ground.

(c) Connect a digital voltmeter between test setup's MOD I/P VOLTS test jack and chassis ground.

(d) Simultaneously monitor oscilloscope and slowly increase output of 24 volt dc power supply until 'modulator drive' pulses just appear on oscilloscope waveform.

NOTE

Storage capacitors A1C1 and A1C2 will be charging to the output voltage of the 24 volt dc power supply. If the current drain exceeds the current limiting function of the power supply, the voltage must be increased at the rate that will allow the capacitors to follow the changing voltage.

(e) Digital voltmeter reading will indicate the charge status of capcitors A1C1/A1C2 and should follow changes in the 24 volt dc power supply voltage.

(f) The 24 volt dc power supply's output voltage and the digital voltmeter indication should be -19 $\pm$2 volts dc.

(g) If the requirements of steps (d) and (f) are met, proceed to step (i).

(h) If the requirements of steps (d) and (f) are not met, the logic circuits of modulator printed circuit board A3 or the logic level transfer circuits of dc offset assembly A1A1 (A1A2) are defective. Isolate fault and repair observing the instructions in paragraph 7.

(i) Set 24 volt dc power supply's output to -24 volts dc.

(j) Oscilloscope waveform should be similar to the 'modulator drive' waveform observed in step (i) of paragraph 5.3.1 (1.4 microsecond 'logic 1' pulses) except the 'logic 0' reference level should be -24 volts dc and the 'logic 1' level should be -11 volts dc (see figure 2 for typical waveform).

(k) Current drain from 24 volt dc power supply should be approximately 300 milliamperes.

NOTE

Current drain from the power supply is dependent on the width of the 'logic 1' 'modulator drive' pulses. 1.4 microsecond pulses will typically result in a current drain of 300 milliamperes.

(l) If the requirements of steps (j) and (k) are met, proceed to step (n).

(m) If the requirements of steps (j) and (k) are not met, and waveform is distorted, one or more power MOSFET's (A1Q1/Q2/Q3/Q4 or A2Q1/Q2/Q3/Q4) are defective. Isolate defective power MOSFET(s) observing instructions in paragraph 6.

(n) Set 24 volt dc power supply's output to zero volts dc and allow sufficient time for storage capacitors A1C1 and A2C1 to discharge.

(o) Connect oscilloscope between terminal B of dc offset assembly A2A1 and chassis ground.

(p) Repeat steps (d) thru (m).

5.3.4 Test of Modulator Output Circuits: Test the modulator output circuits as follows:

(a) Verify requirements of paragraph 5.3.3 have met and -24 volts dc is being applied to test setup's -DCV test jack.

(b) Connect or verify oscilloscope is connected between terminal B of dc offset assembly A1A1 or A2A1 and chassis ground.

(c) Verify 'logic 1' pulses of 'modulator drive' are 1.4 microseconds in duration (10 percent duty cycle).

(d) Connect a digital voltmeter between test setup's MOD O/P VOLTS test jack and chassis ground.

(e) Digtal voltmeter indication should be -2.4 $\pm$ 0.4 volts dc.

(f) Connect digital voltmeter across the test setup's load resistor connected to P2-3/4/5/6/7/8.

(g) Digital voltmeter indication should be the same as the reading observed in step (e).

(h) Vary the width of the 'logic 1' pulses observed on the oscilloscope by adjusting modulator driver module's HIGH CARR LEVEL potentiometer.

NOTE

The maximum width of the 'logic 1' pulses will be limited by the current capability of the 24 volt dc power supply and the Wattage rating of the load resistor.

(i) Digtal voltmeter indication should follow changes in the 'logic 1' pulse width and should be the 'logic 1' duty cycle percentage of -24 volts dc plus or minus five percent.

(j) Switch off 24 volt dc power supply, allow sufficient time for capacitors A1C1 and A2C1 to discharge and then disconnect its leads from the test setup's -DCV and GND test jacks.

(k) Disconnect oscilloscope and digital voltmeter.

5.4 CALIBRATION OF 70 kHz NOTCH FILTER: Calibrate 70 kHz notch filter as follows:

NOTE

The 70 kHz notch filter was precisely calibrated during manufacture and should not require recalibration unless a component of the filter has been replaced, transformer A5T1's core setting has been changed or the transmitter spectrum analysis indicates a 60 kHz sideband which is less than 70 dB below the carrier.

(a) Disconnect transformer A5T1's lead from capacitor C2's terminal.

(b) Connect a signal generator that has been preset to exactly 70 kHz across the lead of transformer A5T1 disconnected in step (a) and the lead of A5T1 that is connected to relay sockets XK1, XK2 and XK3.

(c) Connect an oscilloscope in parallel with the signal generator.

(d) Adjust the metal cover of A5T1, using a non-metalic screwdriver, for maximum peak-to-peak ac voltage waveform on oscilloscope.

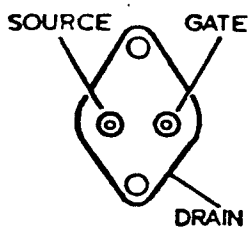
(e) Ensure voltage level does not change when adjustment tool is removed.

(f) Reinstall lead of A5T1, removed in step (a), on capacitor C1's terminal.

5.5 COMPLETION OF TESTS: Modulator modules that meet all of the requirements of paragraphs 5.3 and 5.4 may be considered to be satisfactory and returned to service. Switch off the test setup's 15 volt dc power supply and disconnect modulator module from test setup.

RESISTANCE MEASUREMENT OF POWER MOSFETS

6. Isolate defective power MOSFET's by performing a resistance measurement of each device as follows:



NOTE

The power MOSFET's can be checked while still mechanically mounted on the heat sink porvided their source and gate leads have been electrically isolated.

(a) Unsolder the source and gate leads from the printed wiring pattern, of the device's printed circuit board, on switched regulator extrusion assembly A1 or A2.

(b) Measure the resistance between gate and source using an ohmmeter. Resistance reading should be greater than 20 megohms.

(c) Ensure power MOSFET is turned off by momentarily shorting source and gate leads.

(d) Measure forward source/drain resistance ensuring the ohmmeter's negative lead is on the drain. Resistance reading should be the same as the forward resistance of a diode.

(e) Measure reverse source/drain resistance (connect ohmmeter's negative lead to source). Resistance reading should be greater than 20 megohms.

(f) Turn power MOSFET on by forward biasing gate/source junction (connect ohmmeter's positive lead to gate and negative lead to source).

(g) Measure source/drain resistance. Resistance reading should be less than one ohm.

(h) Power MOSFETs that meet the requirements of steps (a) thru (g) are acceptable.

REPAIR

7. Repair or replace defective components observing the following.

7.1 SWITCHED REGULATOR EXTRUSION ASSEMBLY (A1 or A2): Replace any component, including the power MOSFET's, on the switched regulator extrusion assemblies which are defective as follows.

7.1.1 DC Offset Printed Circuit Board Repair: Gain access to the printed pattern of the dc offset printed circuit board (A1A1 or A2A1) by unsoldering the wiring to terminals A, B and C, removing the two fastening screws and lock washers and then rotating it. Ensure wiring to terminals D and E is not damaged. Reconnect wiring to terminals A, B and C after repairs have been completed and the dc offset printed circuit board has been reinstalled.

7.1.2 Storage Capacitor A1C1/A2C1 Replacement: When replacing storage capacitor A1C1/A2C1, ensure the following is observed:

(a) Ensure plastic moulding is in place on extrusion fins that come in contact with the capacitor.

(b) Ensure negative terminal is located at the bottom securing hole (nearest extrusiuon) and that a shoulder insulator is installed in its securing hole.

(c) If tyraps securing capacitor to extrusion were cut during removal, install new tyraps and ensure they are firmly tightened.

7.1.3 Power MOSFET Replacement: Remove the applicable switched regulator extrusion assembly (A1 or A2) to gain access to the power MOSFET's and replace defective power MOSFET"s as follows:

(a) Disconnect wiring from terminals D and E of dc offset printed circuit board A1A1/A2A1.

(b) Disconnect metal strap connecting negative terminals of A1C1 and A2C1.

(c) Remove four screws and lock washers securing extrusion to chassis, ensuring the standoff pillars are not loosened.

(d) Remove defective power MOSFET.

(e) Install replacement power MOSFET that has been checked in accordance with the instructions in paragraph 6, ensuring:

- an LXP42 ferrite bead has been installed in the gate lead,
- a mica insulating washer has been installed between the power MOSFET and the extrusion,
- mica washer has a thin coating of thermal compound on both sides.

(f) Solder gate and source leads of power MOSFET to printed wiring pattern ensuring leads are not shorted to extrusion.

(g) Reinstall switched regulator extrusion assembly on modulator chassis using four screws and lockwashers removed in step (c).

(h) Reconnect metal strap removed in step (b) to negative terminals of capacitors A1C1 and A2C1, ensuring resistor R5 is connected at negative terminal of A2C1.

(i) Reconnect wiring to terminals D and E, removed in step (a) of dc offset printed circuit board A1A1/A2A1, ensuring conductor is connected to E and shield is connected to D.

7.2 REPAIR OF MODULATOR PRINTED CIRCUIT BOARD (A3): There are no special repair procedures for modulator printed circuit board A3 other than the normal precautions to be observed when handling CMOS devices. Gain access to the printed wiring side of the printed circuit board by removing four fastening screws and swinging the printed circuit board on its cable harness without removing the interconnecting wires. Upon reassembly, ensure the interconnecting wires are not pinched when the screws are tightened.

7.3 REPAIR OF IMBALANCE DETECTOR ASSEMBLY (A4): There are no special repair procedures for imbalance detector assembly A4. Ensure nuts securing leads terminated with solder lugs are firmly tightened when repairs are completed.

7.4 REPAIR OF TRANSFORMER ASSEMBLY (A5): There are no special repair procedures for transformer assembly A5. If adjustable portion of A5 is loose, it may be necessary to remove the cap and apply locking compound to its screw threads. If cap position has been moved, perform the calibration procedures detailed in paragraph 5.4.

7.5 FILTER COIL REPLACEMENT: If a filter coil (L1, L2, L3 or L4) is removed for any reason, the following must be observed during replacement.

(a) Do not loosen nuts or bolts securing ferrite core to mounting brackets unless a ferrite core requires replacement.

(b) Coat threads of bolts securing the ferrite cores to their mounting brackets with a locking compound prior to installing nuts.

(c) Torque the inner nuts on the bolts securing the ferrite cores to their mounting brackets to 10 inch-pounds, noting that over-torquing may crack the ferrite and under-torquing may result in excessive vibrations at the audio modulation frequency.

(d) Install locking nut on each end of bolt, ensuring torque of inner nut does not change.

Table 1 - Test Equipment

NOMENCLATURE	PART, MODEL, OR TYPE NUMBER (EQUIVALENTS MAY BE USED)
Digital Multimeter	3 1/2 digit, ac and dc volts, ohms and amps, ±0.5% accuracy. Beckman 3010
Oscilloscope	15 MHz. Tektronics Model T922
15 Vdc Power Supply	15 Volts 1 Amp
24 Vdc Power Supply	24 Volts 1 Amp
Load	0.625 ohms, 100 Watt
Audio Signal Generator	10 Hz to 10 MHz, 600 ohms, 0 to +15 dBm, Hewlett Packard model 651B
Test Setup	As depicted in figure 1

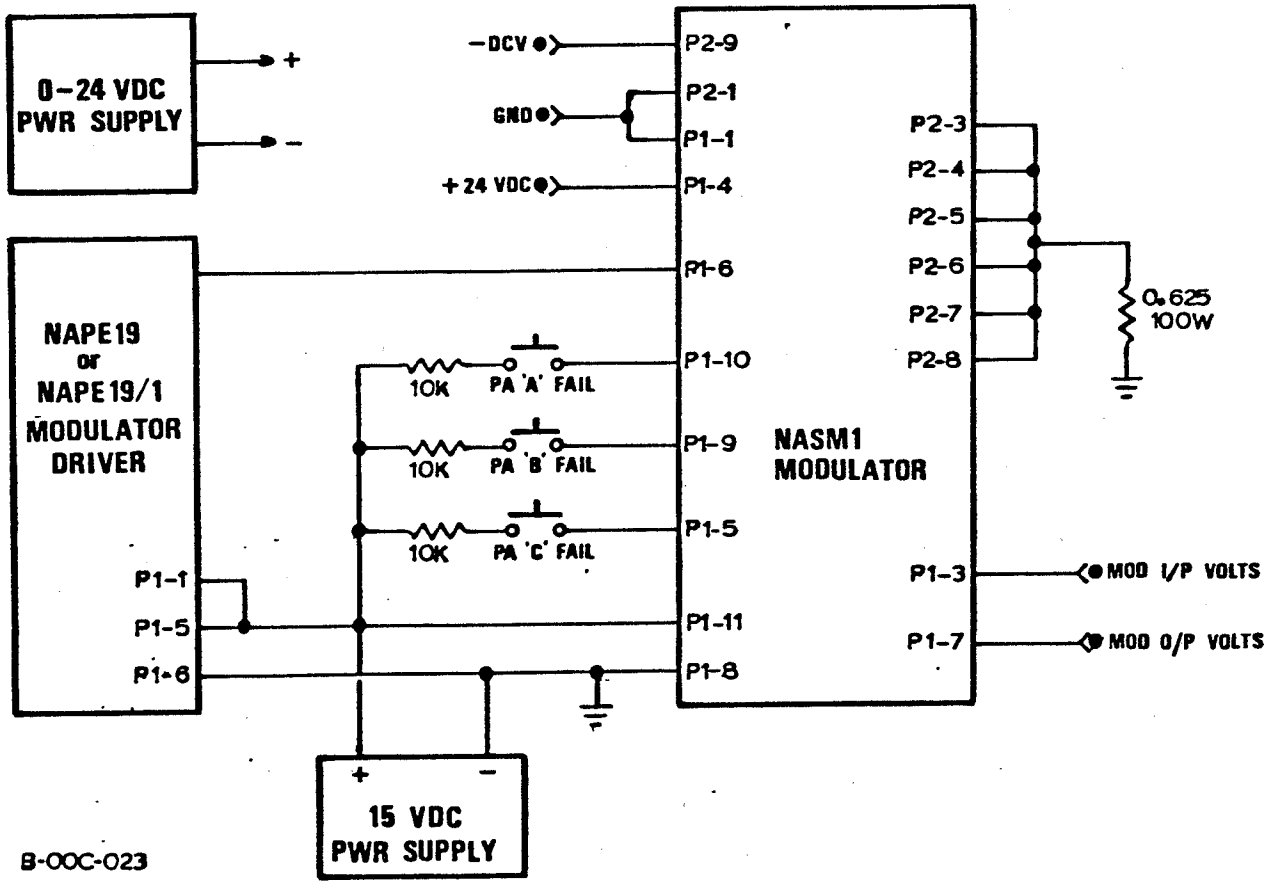
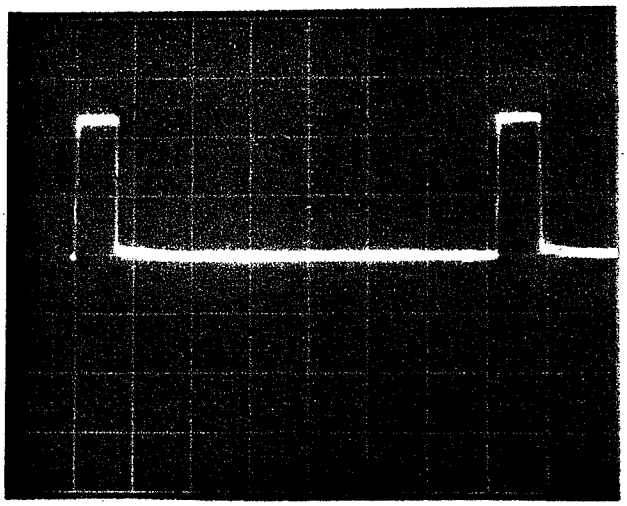


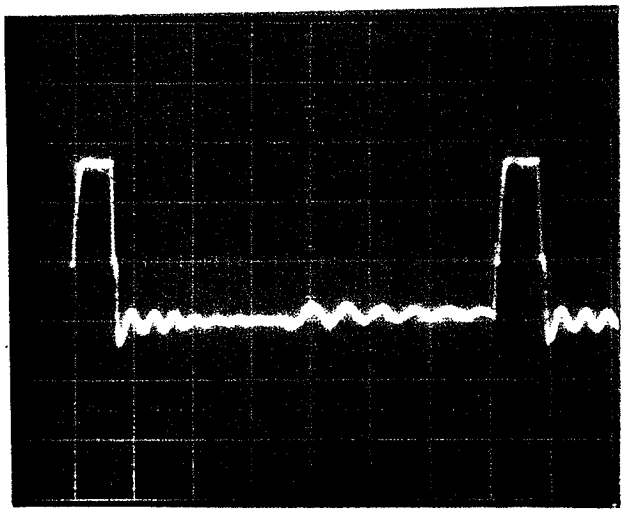
Figure 1 - Test Setup - NASM1A Modulator Module



MODULATOR DRIVE

Terminal B of A3

5 volts/division
2 usec/division
0 volts dc at center of screen



DC OFFSET OUTPUT

Terminal B of A1A1 or A2A1

5 volts/division
2 usec/division
lower reference at -24 volts dc (-DCV)

Figure 2 Modulator Waveforms

Table 2 Wiring List - NASM1A Modulator Module

SOURCE	DESTINATION	CODE		SIZE	FUNCTION
A1C1/A2C1 Jct	Teflon terminal	RWP10	Resistor	1000 ohms	R1
XDS1-Gnd Lug	Insul standoff	RWP10	Resistor	1000 ohms	R2
C2-2	Ground	RJ04	Resistor	5600 ohms	R3
XDS1 Cathode	Insul standoff	RAP10	Resistor	1800 ohms	R4
P1-6	A3-B	RAP08	Resistor	560 ohms	R5
P1-1	Ground	1	Black	14	
P1-8	Ground	2	Black	14	
P1-12	Ground	3	Black	14	
P2-1	Ground	4	Black	14	
P1-11	F1-1	5	Red	22	
F1-2	A3-A	6	Red	22	
P1-4	F2-1	7	Orange	22	
F2-2	A3-R	8	Orange	22	
-	-	9	Not Used		
P1-3	A3-N	10	Blue	22	
P1-5	A3-E	11	White	22	
P1-9	A3-D	12	White	22	
P1-10	A3-C	13	White	22	
K3-13	A3-R	14	Orange	22	
K3-14	A3-M	15	White	22	
K2-13	A3-X	16	Orange	22	
K2-14	A3-L	17	White	22	
K1-13	A3-W	18	Orange	22	
K1-14	A3-K	19	White	22	
A3-G	A1A1-E	20	Core	RG188A/U	(WE38)
A3-Ground	A1A1-D	-	Shield	-	
A3-J	A2A1-E	21	Core	RG188A/U	(WE38)
A3-Ground	A2A1-D	-	Shield	-	
C2-2	CR1 Cathode	22	White	22	
CR1 Cathode	A3-H	23	White	22	
A3-H	P1-7	24	White	22	
A3-P	TP1-1	25	White	22	
A3-N	CR1 Anode	26	Blue	22	
A1C1/A2C1 Jct	CR1 Anode	27	Blue	22	
A3-V	XDS2 Anode	28	Orange	22	
XDS2 Anode	XDS3 Anode	29	Orange	22	
XDS3 Anode	XDS4 Anode	30	Orange	22	
XDS4 Cathode	A4-9	31	White	22	
A4-2	A3-U	32	White	22	
XDS3 Cathode	A4-8	33	White	22	
A4-1	A3-T	34	White	22	
XDS2 Cathode	A4-10	35	White	22	
A4-3	A3-S	36	White	22	
A4-5	A3-F	37	Black	22	
Teflon terminal	Insul standoff	38	Blue	22	
-	-	39	Not Used		
A4-4	A3-A	40	Red	22	
P2-3	K1-12	41	White	16	
P2-4	K1-9	42	White	16	
P2-5	K2-12	43	White	16	

Table 2 Wiring List - NASM1A Modulator Module (Continued)

SOURCE	DESTINATION	CODE		SIZE	FUNCTION
P2-6	K2-9	44	White	16	
P2-7	K3-12	45	White	16	
P2-8	K3-9	46	White	16	
K3-5	K3-8	47	Tinned Copper	22	
K3-8	K2-5	48	Tinned Copper	22	
K2-5	K2-8	49	Tinned Copper	22	
K2-8	K1-5	50	Tinned Copper	22	
K1-5	K1-8	51	Tinned Copper	22	
K1-8	Ground	52	Black	22	
-	-	53	Not Used		
-	-	54	Not Used		
-	-	55	Not Used		
-	-	56	Not Used		
-	-	57	Not Used		
-	-	58	Not Used		
P2-9	A1C1/A2C1 Jct	59	White	14	
P2-10	A1C1/A2C1 Jct	60	White	14	
P2-11	A1C1/A2C1 Jct	61	White	14	
P2-12	A1C1/A2C1 Jct	62	White	14	
L1-2	A4-12	-	-	lead of L1	
L2-2	A4-11	-	-	lead of L2	
L3-2	C2-2	-	-	lead of L3	
L1-1	A4-7	-	-	lead of L1	
L2-1	A4-6	-	-	lead of L2	
L3-1	C1-2	-	-	lead of L3	
L4-1	C1-2	-	-	lead of L4	
A4-K1	C1-2	-	-	2 leads of A4K1	
K3-1	K3-4	@	-		
K3-4	K2-1	@	-		
K2-1	K2-4	@	-		
K2-4	K1-1	@	-		
K1-1	K1-4	@	-		
K2-4	A5T1-1	@	-		
A5T1-2	C2-2	@	-		
A1Q1-Drain	A4-12	-	White	10	Part of A1
A2Q1-Drain	A4-11	-	White	10	Part of A2
L4-2	C2-2	-	-	Lead of L4	
C1-1	Ground	-	Metal Strap		
C2-1	Ground	-	Metal Strap		
A1C1	A1C2	-	Metal Strap		
XDS1 Anode	XDS1 Gnd Lug	-	Black	22	

@ Denotes connected with continuous strap

Table 3 NASM1A Modulator Module Reference Designation Index

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE
-	Modulator Assembly	NASM1A	139-2000-2	37338
A1	Switched Regulator Extrusion Assembly	139-2020-1	139-2020-1	37338
A1A1	DC Offset PCB Assembly	139-2054	139-2054	37338
A1A1Q1	Transistor, PNP	QB11	2N5416	04713
A1A1Q2	Transistor, NPN	QAP06	2N2222	04713
A1A1Q3	Transistor, PNP	QAP09	2N2907	04713
A1A1R1	Resistor, Film, 47 ohms, 2% 1/2W	RC21	RL20S470G	36002
A1A1R2	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A1A1R3	Resistor, Comp, 5600 ohms, 5% 2W	RJ04	RC42GF562J	36002
A1C1	Capacitor, Electrolytic, 30000uF, 100V	CCD17	3188GN303T100AHA1	56699
A1C2	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A1C3	Not Used			
A1C4	Not Used			
A1C5	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
A1C6	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
A1C7	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
A1C8	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
A1CR1	Diode, Zener, 13V, 1.5W, 5%	QK31	1N5928B	04713
A1CR2	Not Used			
A1CR3	Diode	QK16	1N5816	12969
A1L1	Ferrite Bead	LXP42	11-010-B	33062
A1L2	Ferrite Bead	LXP42	11-010-B	33062
A1L3	Ferrite Bead	LXP42	11-010-B	33062
A1L4	Ferrite Bead	LXP42	11-010-B	33062
A1Q1	Transistor, Field Effect, N Channel	QA04	IRF130	81483
A1Q2	Transistor, Field Effect, N Channel	QA04	IRF130	81483
A1Q3	Transistor, Field Effect, N Channel	QA04	IRF130	81483
A1Q4	Transistor, Field Effect, N Channel	QA04	IRF130	81483
A1Q5	Transistor, NPN, High Gain, Low Noise	QA35	2N930	04713
A2	Same as A1			
A3	Modulator PCB Assembly	139-2051	139-2051	37338
A3C01	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
A3C02	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
A3C03	Capacitor, Ceramic, 0.47uF 10%, 50V	CCG09	CKR06BX474KL	56289
A3C04	Capacitor, Ceramic, 0.47uF 10%, 50V	CCG09	CKR06BX474KL	56289
A3C05	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
A3C06	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
A3C07	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
A3C08	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A3C09	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A3C10	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A3C11	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
A3L1	Toroid	LY09	11-122-B	33062
A3L2	Toroid	LY09	11-122-B	33062
A3L3	Toroid	LY09	11-122-B	33062
A3Q01	Transistor, NPN	QA35	2N930	04713
A3Q02	Transistor, NPN	QAP06	2N2222	04713
A3Q03	Transistor, NPN	QAP06	2N2222	04713
A3Q04	Thyristor	QB16	MCR203	04713

Table 3 NASM1A Modulator Module Reference Designation Index (Continued)

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE
A3Q05	Thyristor	QB16	MCR203	04713
A3Q06	Thyristor	QB16	MCR203	04713
A3R01	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A3R02	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A3R03	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A3R04	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A3R05	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A3R06	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A3R07	Resistor, Film, 47K ohms, 2% 1/2W	RD15	RL20S473G	36002
A3R08	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A3R09	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A3R10	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A3U1	IC, CMOS, Quad, 2-input AND Gates	UB20	MC14081BAL	04713
A3XU1	Socket, Integrated Circuit, 14-pin	UC02	640357-1	00779
A4	Imbalance Detector Assembly	139-2033-1	139-2033-1	37338
A4C1	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL	56289
A4CR1	Diode	QAP29	1N4938	01295
A4CR2	Diode	QAP29	1N4938	01295
A4CR3	Diode	QAP29	1N4938	01295
A4K1	Relay	139-2035	139-2035	37338
A4Q1	Thyristor	QB15	2N2326	04713
A4R1	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A4R2	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A4R3	Resistor, Film, 1800 ohms, 2% 1/2W	RAP10	RL20S182G	36002
A4R4	Resistor, Film, 1800 ohms, 2% 1/2W	RAP10	RL20S182G	36002
A4R5	Resistor, Film, 1800 ohms, 2% 1/2W	RAP10	RL20S182G	36002
A5	Transformer Assembly	139-2045	139-2045	37338
A5C1	Capacitor, Mylar, 0.33uF 10%, 200V	CNP09	MFP2P33-10	14655
A5C2	Capacitor, Mylar, 0.33uF 10%, 200V	CNP09	MFP2P33-10	14655
A5T1	Transformer	139-2096	139-2096	37338
C1	Capacitor, Paper-oil, 20uF 10%, 200V	CCD08	365P206X9200C4OPX	56289
C2	Capacitor, Paper-oil, 10uF 10%, 200V	CCD07	365P106X9200A4OPX	56289
CR1	Diode	QK17	1N1187A	04713
DS1	Diode, Light Emitting, Amber	QK14	5082-4592	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
F1	Fuse, 1/4 Amp, Slow Blow	FB11	323.250	75915
F2	Fuse, 1/2 Amp, Slow Blow	FB13	MDL-250V-1/2A	71400
K1	Relay, 24Vdc	KB38	K10P11D1524	77342
K2	Relay, 24Vdc	KB38	K10P11D1524	77342
K3	Relay, 24Vdc	KB38	K10P11D1524	77342
L1	Inductor	139-2017	139-2017	37338
L2	Inductor	139-2017	139-2017	37338
L3	Inductor	139-2017	139-2017	37338
L4	Inductor	139-2017	139-2017	37338
P1	Connector, Plug, 11-pin	J012	P3G-5411-SB	13150
P2	Connector, Plug, 11-pin	J012	P3G-5411-SB	13150

Table 3 NASM1A Modulator Module Reference Designation Index (Continued)

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE
R1	Resistor, Wirewound, 1000 ohms, 5% 5W	RWP10	RS5-1000 Ohms-5%	35005
R2	Resistor, Wirewound, 1000 ohms, 5% 5W	RWP10	RS5-1000 Ohms-5%	35005
R3	Resistor, Comp, 5600 ohms, 5% 2W	RJ04	RC42GF562J	36002
R4	Resistor, Film, 1800 ohms, 2% 1/2W	RAP10	RL20S182G	36002
R5	Resistor, Film, 560 ohms, 2% 1/2W	RAP08	RL20S561G	36002
TP1	Jack, Tip, Violet	J020	450-4355-1-0317	71279
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
XF1	Fuse Block	FA25	357002	75915
XK1	Relay, Socket (c/w Spring P/N 20C217)	KB39	27E488	77342
XK2	Relay, Socket (c/w Spring P/N 20C217)	KB39	27E488	77342
XK3	Relay, Socket (c/w Spring P/N 20C217)	KB39	27E488	77342

Table 4 NASM1A Modulator Module Quantities Per Unit Index

NAUTEL'S PART NO.	NAME OF PART AND DESCRIPTION	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE	TOTAL IDENT PARTS
NASM1A	Modulator Assembly	139-2000-2	37338	REF
139-2017	Inductor	139-2017	37338	4
139-2020-1	Switched Regulator Extrusion Assembly	139-2020-1	37338	2
139-2033-1	Imbalance Detector Assembly	139-2033-1	37338	1
139-2035	Relay	139-2035	37338	1
139-2045	Transformer Assembly	139-2045	37338	1
139-2051	Modulator PCB Assembly	139-2051	37338	1
139-2054	DC Offset PCB Assembly	139-2054	37338	2
139-2096	Transformer	139-2096	37338	1
CCD07	Capacitor, Paper-oil, 10uF 10%, 200V	365P106X9200A4OPX	56289	1
CCD08	Capacitor, Paper-oil, 20uF 10%, 200V	365P206X9200C4OPX	56289	1
CCD17	Capacitor, Electrolytic, 30000uF, 100V	3188GN303T100AHA1	56699	2
CCG04	Capacitor, Ceramic, 0.01uF 10%, 100V	CKR05BX103KL	56289	1
CCG07	Capacitor, Ceramic, 0.1uF 10%, 100V	CKR06BX104KL	56289	10
CCG09	Capacitor, Ceramic, 0.47uF 10%, 50V	CKR06BX474KL	56289	2
CCP19	Capacitor, Tantalum, 6.8uF 10%, 35V	CSR13F685KM	56289	4
CCP24	Capacitor, Tantalum, 1.0uF 10%, 50V	CSR13G105KM	56289	4
CNP09	Capacitor, Mylar, 0.33uF 10%, 200V	MFP2P33-10	14655	2
FA25	Fuse Block	357002	75915	1
FB11	Fuse, 1/4 Amp, Slow Blow	323.250	75915	1
FB13	Fuse, 1/2 Amp, Slow Blow	MDL-250V-1/2A	71400	1
J012	Connector, Plug, 11-pin	P3G-5411-SB	13150	2
J020	Jack, Tip, Violet	450-4355-1-0317	71279	1
KB38	Relay, 24Vdc	K10P11D1524	77342	3
KB39	Relay, Socket (c/w Spring P/N 20C217)	27E488	77342	3
LXP42	Ferrite Bead	11-010-B	33062	8
LY09	Toroid	11-122-B	33062	3
QA04	Transistor, Field Effect, N Channel	IRF130	81483	8
QA35	Transistor, NPN, High Gain, Low Noise	2N930	04713	3
QAP06	Transistor, NPN	2N2222	04713	4
QAP09	Transistor, PNP	2N2907	04713	2
QAP29	Diode	1N4938	01295	3
QB11	Transistor, PNP	2N5416	04713	2
QB15	Thyristor	2N2326	04713	1
QB16	Thyristor	MCR203	04713	3
QK13	Diode, Light Emitting, Red	5082-4693	50434	3
QK14	Diode, Light Emitting, Amber	5082-4592	50434	1
QK16	Diode	1N5816	12969	2
QK17	Diode	1N1187A	04713	1
QK25	Socket, LED	PS-200-B	15513	4
QK31	Diode, Zener, 13V, 1.5W, 5%	1N5928B	04713	2
RAP08	Resistor, Film, 560 ohms, 2% 1/2W	RL20S561G	36002	1
RAP09	Resistor, Film, 1000 ohms, 2% 1/2W	RL20S102G	36002	7
RAP10	Resistor, Film, 1800 ohms, 2% 1/2W	RL20S182G	36002	4
RAP12	Resistor, Film, 5600 ohms, 2% 1/2W	RL20S562G	36002	2
RAP13	Resistor, Film, 10K ohms, 2% 1/2W	RL20S103G	36002	4
RC21	Resistor, Film, 47 ohms, 2% 1/2W	RL20S470G	36002	2

Table 4 NASM1A Modulator Module Quantities Per Unit Index (Continued)

NAUTEL'S PART NO.	NAME OF PART AND DESCRIPTION	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE	TOTAL IDENT PARTS
RD15	Resistor, Film, 47K ohms, 2% 1/2W	RL20S473G	36002	1
RJ04	Resistor, Comp, 5600 ohms, 5% 2W	RC42GF562J	36002	3
RWP10	Resistor, Wirewound, 1000 ohms, 5% 5W	RS5-1000 Ohms-5%	35005	2
UB20	IC, CMOS, Quad, 2-input AND Gates	MC14081BAL	04713	1
UC02	Socket, Integrated Circuit, 14-pin	640357-1	00779	1

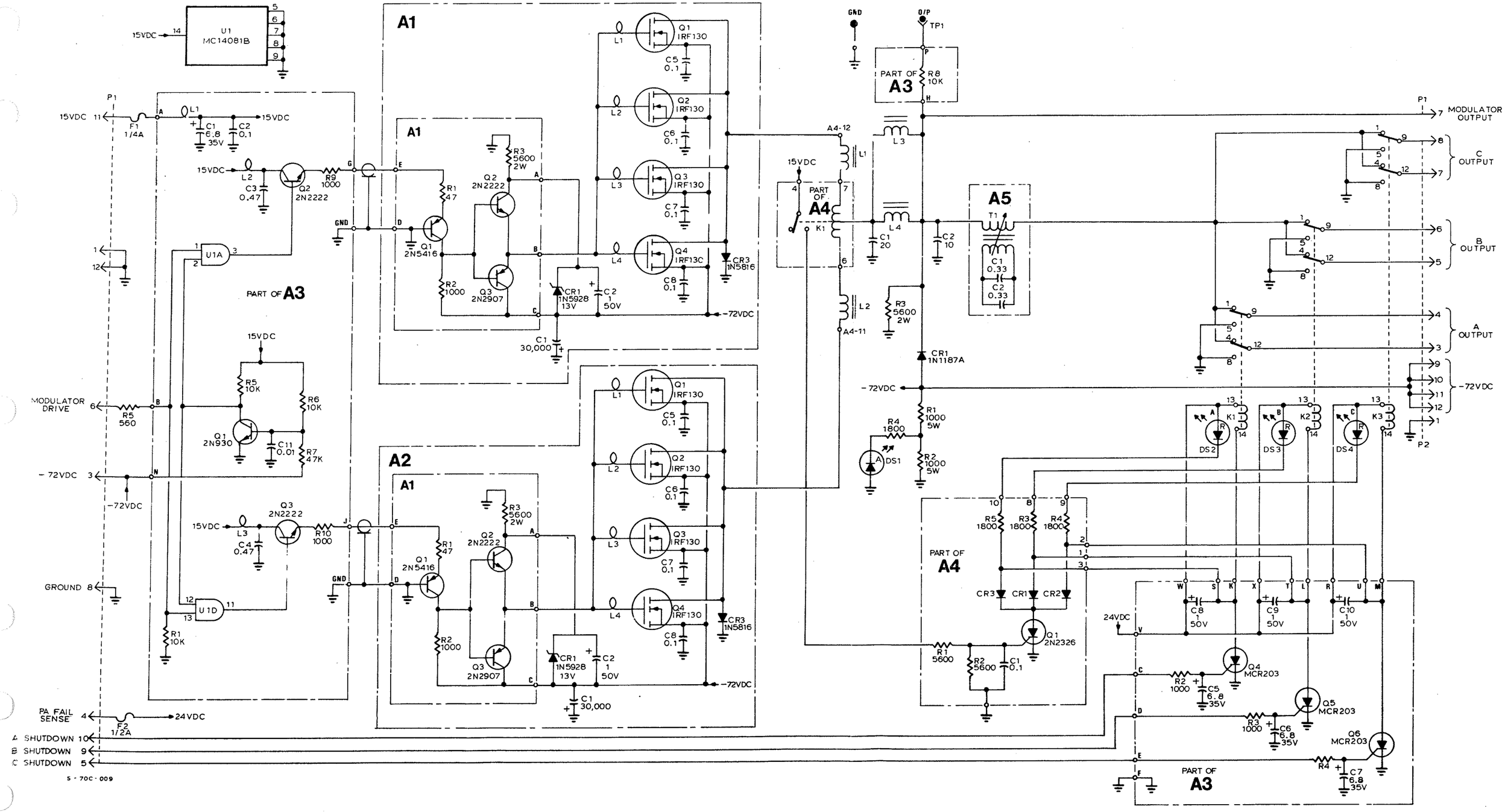


Figure 3 Electrical Schematic - NASM1A Modulator Module

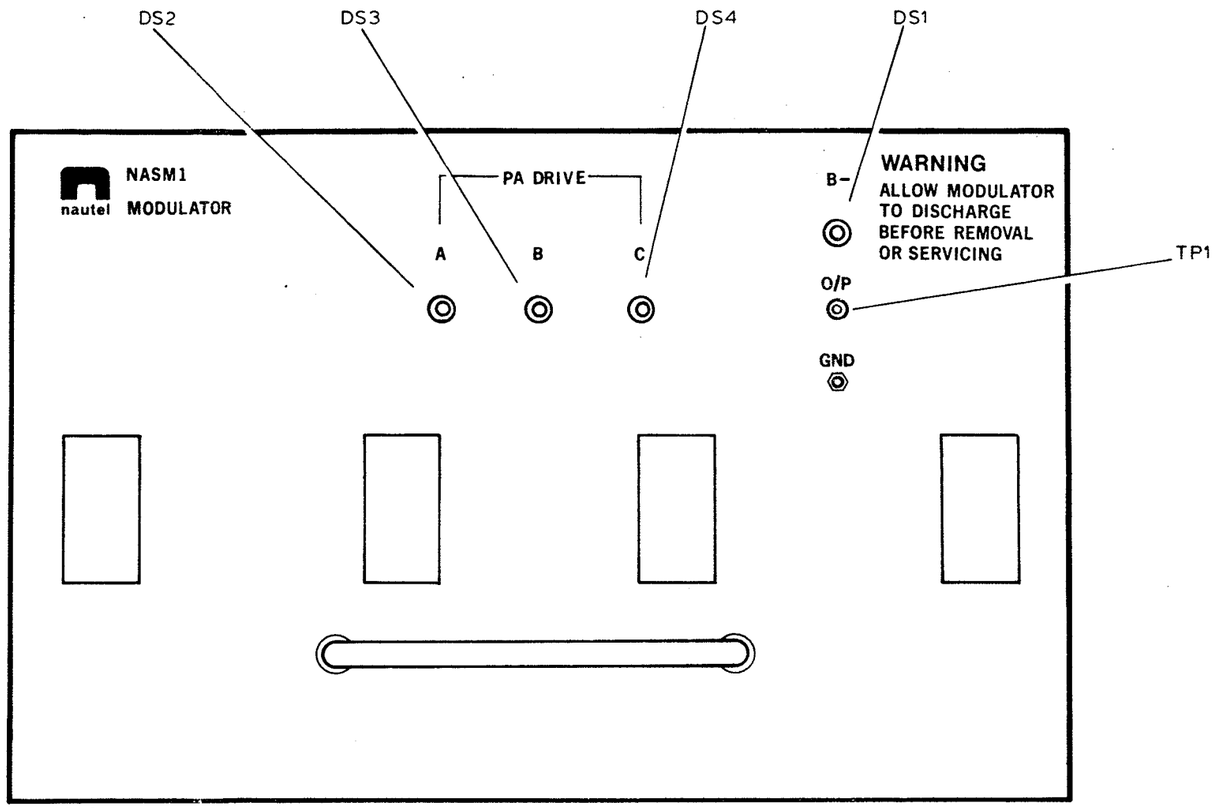


Figure 4 Assembly Detail - NASM1A Modulator Module (Front View)

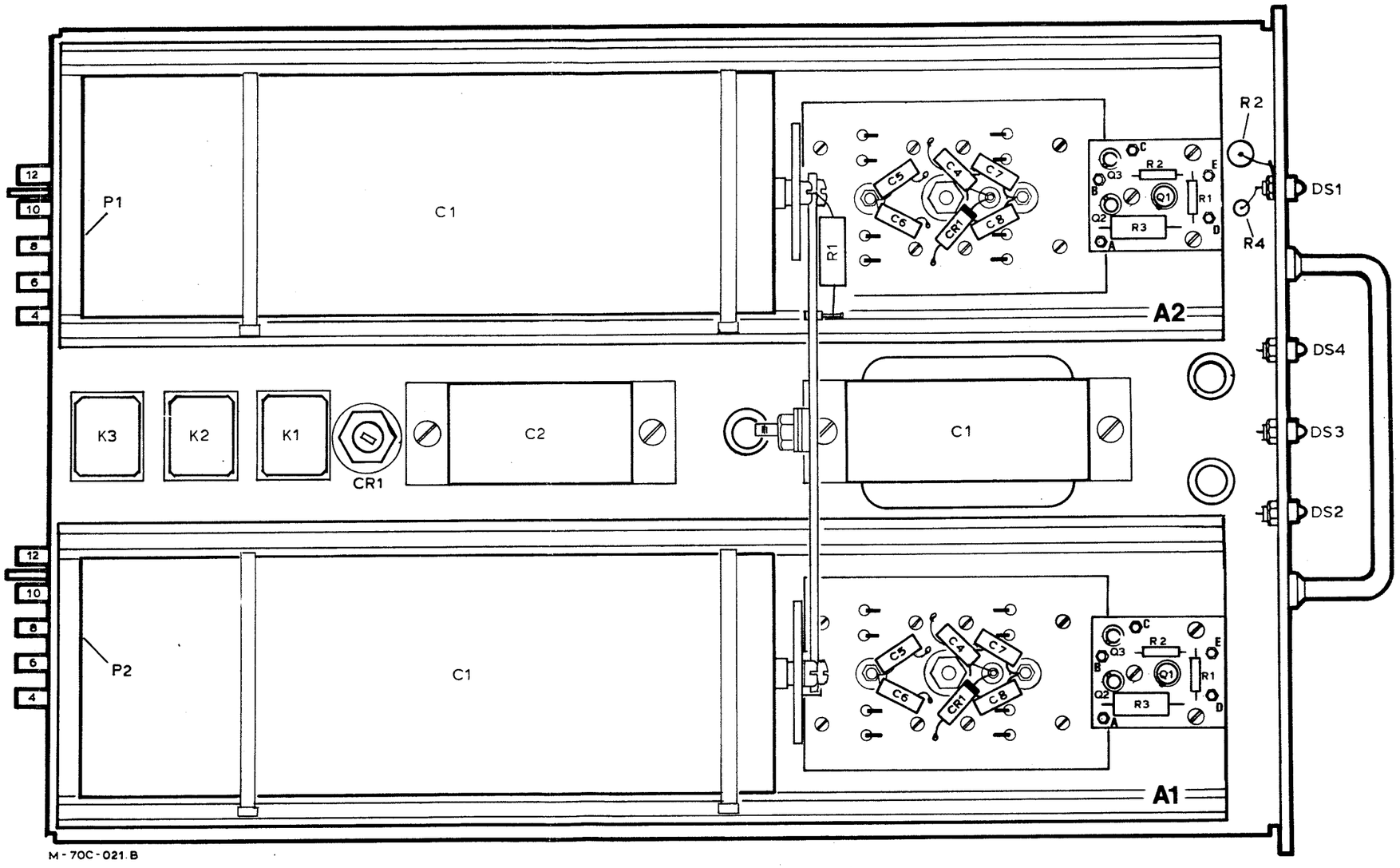


Figure 5 Assembly Detail - NASM1A Modulator Module, Top View

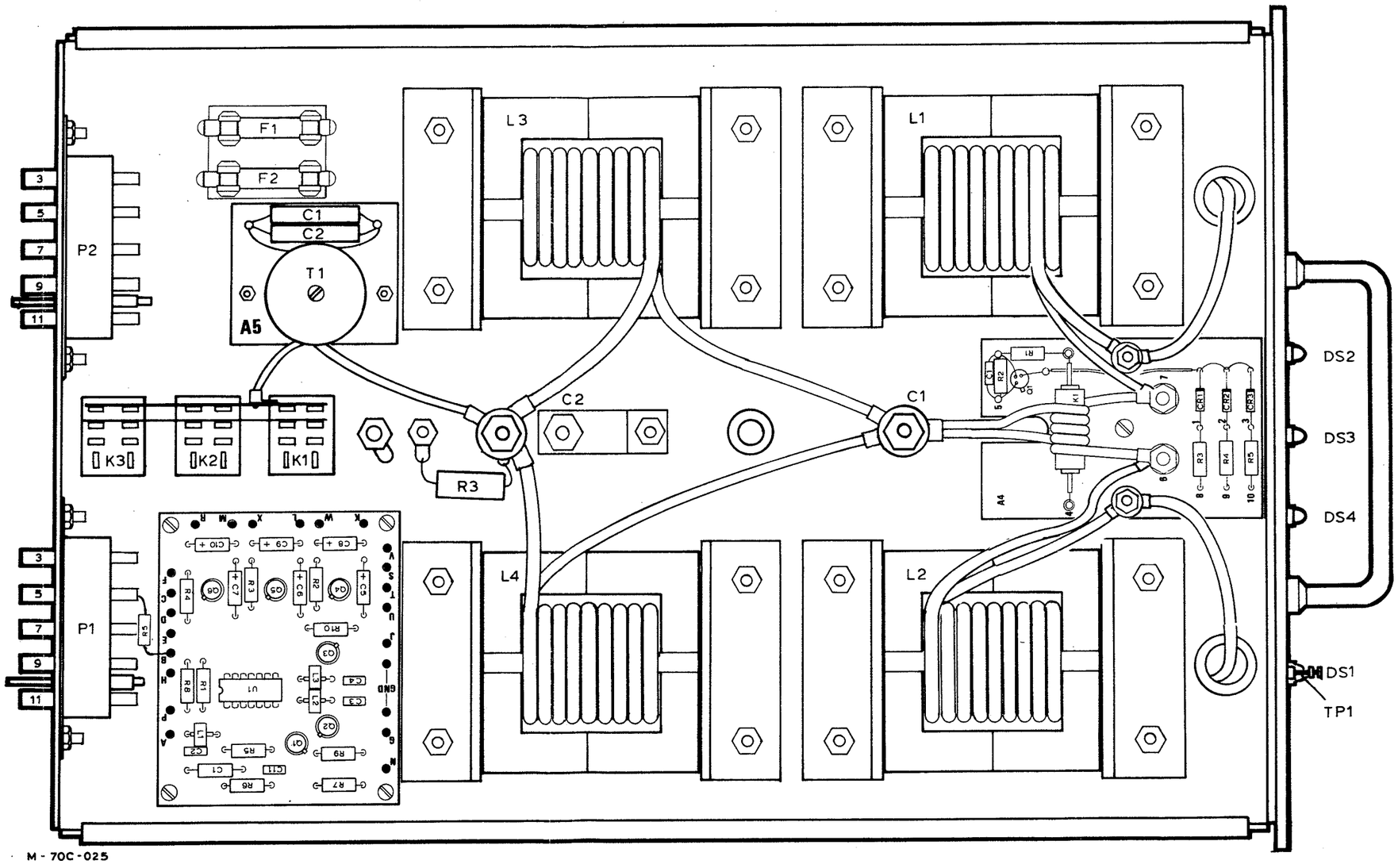
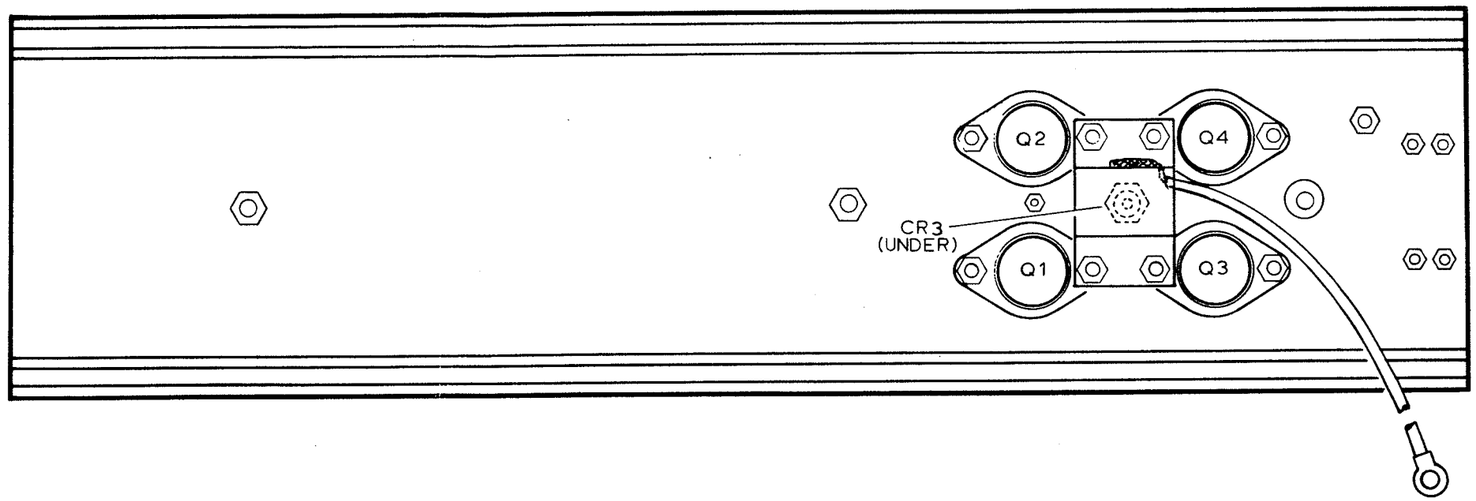


Figure 6 Assembly Detail - NASM1A Modulator Module, Bottom View



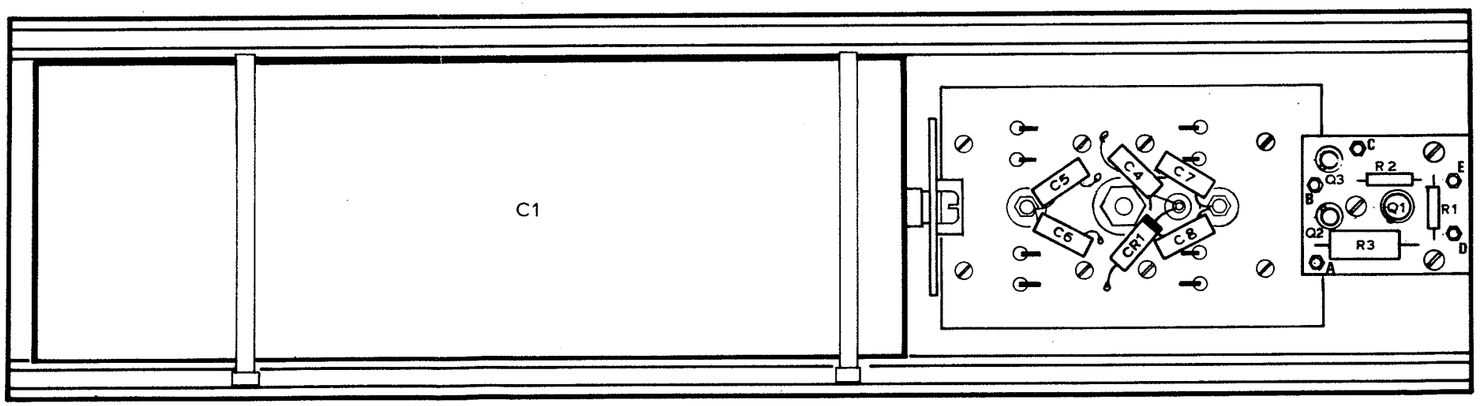


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Figure 7 Assembly Detail - Switched Regulator Extrusion (A1/A2)