

MAINTENANCE MANUAL

POWER AMPLIFIER ASSEMBLY (VHF)

N29/85154000930 148-170 MHz

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DESCRIPTION

The power Amplifier (PA) board is mounted on an aluminum diecast heatsink at the rear of the radio. A brass shield plate covers the heatsink to prevent RF leakage. The entire assembly may be disassembled by loosening two screws.

The PA board amplifies the output from the main board (approximately 1.5 watts) to a level of approximately 40-45 watts over the frequency range of 148-174 MHz. There are no tuning adjustments on the board.

The board consists of a two stage bipolar RF power amplifier, a TX/RX PIN diode switch, a power detection circuit and a low pass filter for harmonics suppression. A diode/overvoltage transient suppressor is also included on the board for reverse voltage and transient protection, as well as a multi-pin connector used to distribute non amplifier related signals to the main board. A 2-pin connector provides 8 volts to bias the PIN diodes, a detector diode, and feeds the detected DC voltage back to the power control circuit on the main board. All connector pins are decoupled with feedthru capacitors. One coaxial cable supplies drive to the power amplifier and the other feeds received signal back to the receiver.

CIRCUIT ANALYSIS

The exciter output from the main board (1.5 watts, 50 ohm impedance) is matched to the base of Q1 by C10, L1, C8 and C9. L10 and R22 provide a bias return for class "C"

operation and enhance low frequency stability. The inter-stage matching is comprised of C5, C7 and a microstrip line. L8, R21 and R23 form a bias return for Q2 and also serve to enhance stability. Once the drive is amplified to 40 watts by Q2, the output is matched back to 50 ohms by C11, C13, C14, L3 and a microstrip line.

A + is supplied to the collector of Q1 and Q2 through a network consisting of C1, L11, C27, L12, R19, L13, C4, C28, L14, R20 and L15. In addition to enhancing stability, these components also suppress the leakage of RF onto the A + line.

The amplifier output feeds transmit PIN diode switch D2. During transmit, switched 8 volts is applied through R1, R2, L16, L6 and L17, turning on PIN diodes D2 and D3 with bias current set at 40 mA. D3 provides an RF path to ground to protect the receiver during transmit. L6, C21 and C15 form a lumped quarter-wave line providing isolation between the switches.

The low pass filter formed by L4, L5, C16, C17 and C18 reduces the harmonic output from the transmitter. The low pass filter then feeds a directional coupler which provides a sample of transmitter power to Schottky diode D4 which develops a DC voltage proportional to the transmitter power and feeds the power control circuit. The diode is biased by R9 and R3. C19 is a blocking capacitor which prevents DC from appearing at the antenna.

Diode D1 provides reverse voltage protection. If voltage is accidentally reversed, this diode will conduct causing the A + fuse in the power cable to blow thereby removing power from the radio and preventing serious damage.

The power amplifier is powered by A + which runs directly from the car battery. It is decoupled by a feedthru capacitor to prevent RF interference from leaking into the supply line. Other non amplifier related signals are routed through the PA board for distribution to the Main Board. These include **IGN A+**, **EXT_ALARM**, **EXT_SPKR** and **SPKR_LO**. They are decoupled by a set of feedthru capacitors on J10 to prevent RF interference from leaking out of the Power Amplifier and into the Main Board. A wiring harness plugs into J10.

SERVICE NOTES

1. Remove all power from the radio before servicing the PA board. The power switch does not remove A+ from the board.
2. To remove the PA assembly, loosen the two retaining screws on the rear of the heat sink. Unplug the two coax cables from the Main printed wire board and the two connectors on the PA.
3. The chip mica capacitors are easily damaged and should be replaced with new parts if removed. Solder them in the exact positions shown in outline diagram as defined by the solder mask. Failure to do so will have adverse effects on the performance.

TROUBLESHOOTING GUIDELINES

1. Check for 13 volts at the A + supply line.
2. Check the PA for open loop functioning by first grounding **DET_PWR**. Check that input drive from the Exciter is at least 1.5 Watts.
3. Check for proper current consumption. It should be around 8-10 Amps.
4. Check for approximately 6.5 volts across resistors R1 or R2. If not present, check PIN diodes D2 and D3, and the DC path from **8V_SW** to L13.
5. With the transmitter unkeyed, check for approximately 4 volts across R5. If not present, check bias path R5, D4 and R6.

PA TRANSISTOR Q1 REPLACEMENT

1. Remove the two retaining screws securing the PA transistor to the heatsink.
2. Unsolder the three leads of the transistor and the ground strap around the flange of the transistor. Remove the

transistor from the PC board, taking care not to damage the board or the adjacent capacitors.

3. Remove all excess solder from the board near the transistor and clean the board to allow new transistor to be positioned properly. Trim off the narrow part of the transistor leads.
4. Apply a thin layer of thermal compound to the back of the transistor and place it in the mounting cutout.
5. Tighten the transistor mounting screws using a moderate torque of 0.5 Newton-metre (4.5 inch-pounds).
6. Solder the transistor leads to the printed board. Again take care not to damage the adjacent capacitors.
7. Remove any residue flux.

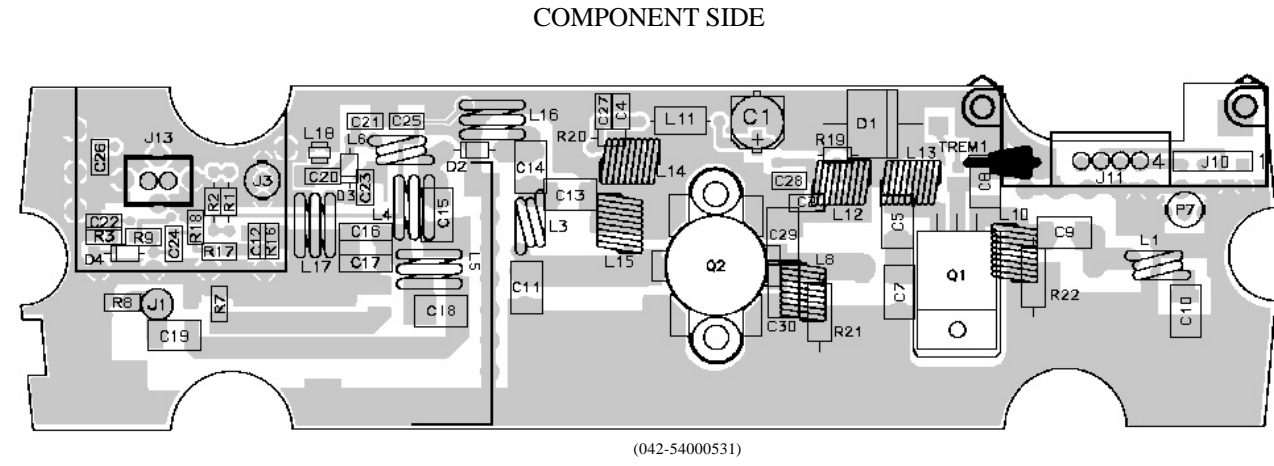
PA TRANSISTOR Q2 REPLACEMENT

1. Remove the two retaining screws securing the PA transistor to the heatsink.
2. Unsolder the six leads of the transistor, and remove it from the PC board. Take care not to damage the board or the adjacent capacitors.
3. Remove all excess solder from the board near the transistor and clean the board to allow new transistor to be positioned properly. Trim the new transistor leads (if required) to the lead length of the removed transistor.
4. Apply a thin layer of thermal compound to the back of the transistor and place it in the mounting cutout. Make sure that the base and collector are not reversed.
5. Tighten the transistor mounting screws using a moderate torque of 0.5 Newton-metre (4.5 inch-pounds).
6. Solder the transistor leads to the printed board. Again take care not to damage the adjacent capacitors.
7. Remove any residue flux.

**MDS CONVENTIONAL RADIO (VHF)
POWER AMPLIFIER ASSEMBLY
N29/85154000930 (148-174 MHz)
ISSUE 1**

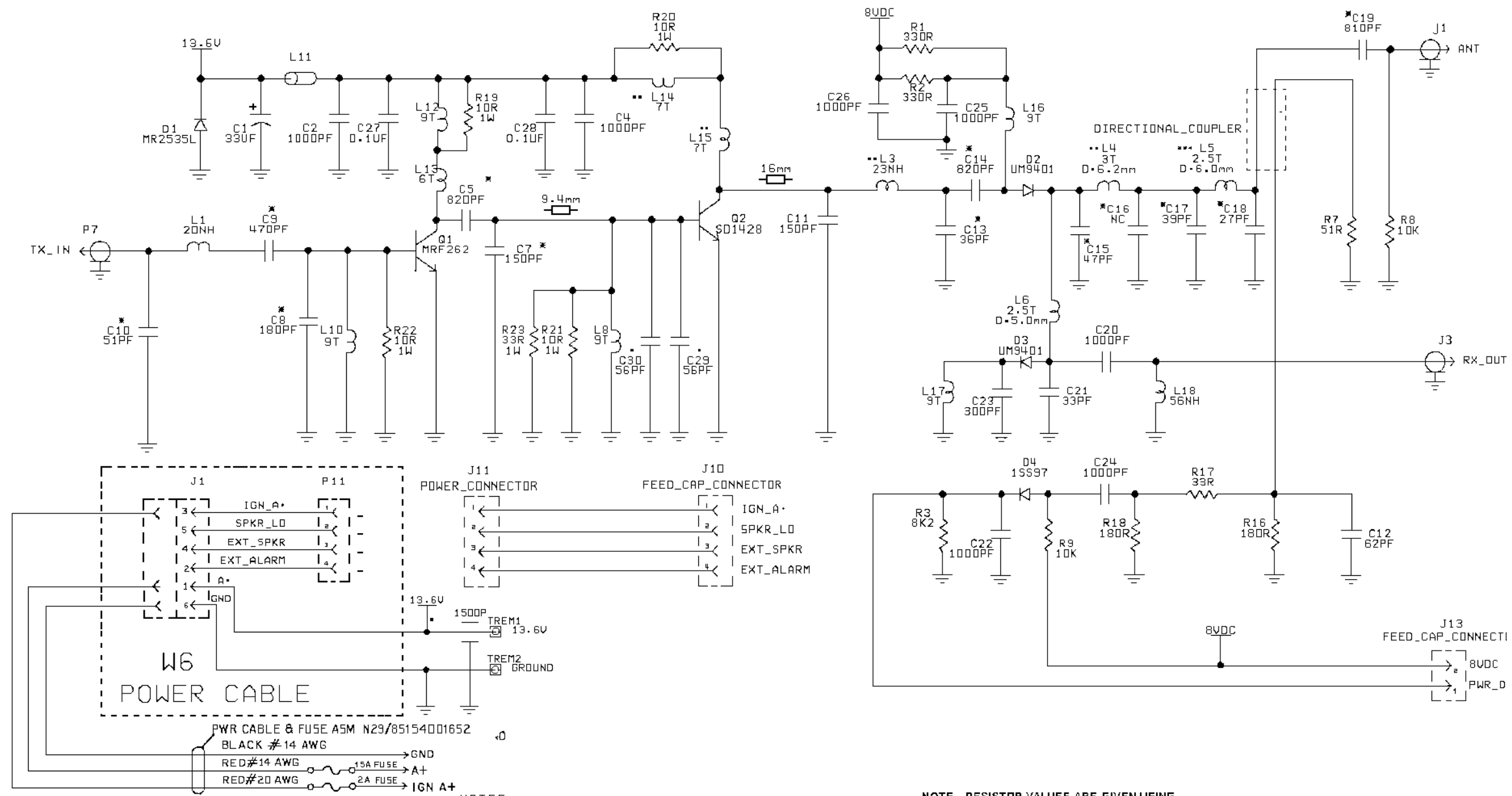
SYMBOL	PART NUMBER	DESCRIPTION
----- CAPACITORS -----		
C1		Surface mount: 33 uF, 25 V.
C2	19A702052P5	Surface mount: 1000 pF, 50 V.
C4	19A702052P5	Surface mount: 1000 pF, 50 V.
C5		Surface mount: 810 pF, 100 V.
C7		Surface mount: 150 pF, 100 V.
C8		Surface mount: 180 pF, 100 V.
C9		Surface mount: 470 pF, 100 V.
C10	19A705108P30	Surface mount: 51 pF, 500 V.
C11		Surface mount: 150 pF, 100 V.
C12		Surface mount: 62 pF, 50 V.
C13	19A705108P26	Surface mount: 36 pF, 500V.
C14		Surface mount: 810 pF, 100 V.
C15	19A705108P29	Surface mount: 47 pF, 500 V.
C17	19A705108P27	Surface mount: 39 pF, 500 V.
C18	19A705108P22	Surface mount: 24 pF, 500 V.
C19		Surface mount: 810 pF, 100 V.
C20	19A702052P5	Surface mount: 1000 pF, 50 V.
C21	19A702236P38	Surface mount: 33 pF, 50 V.
C22	19A702052P5	Surface mount: 1000 pF, 50 V.
C23		Surface mount: 300 pF, 50 V.
C24 thru C26	19A702052P5	Surface mount: 1000 pF, 50 V.
C27 and C28	19A702052P33	Surface mount: .1 uF, 25 V.
C29 and C30	19A705108P31	Surface mount: 56 pF, 500 V.
----- DIODE -----		
D1		Transorb MR2535L.
D2 and D3	19J706892P2	Silicon: 1.5 watt, 50V, UM9401.
D4	B19/5TXAA00326	Diode: SCK 1SS97.
----- COILS -----		
L1		Coil: #19x1.5Tx2.1.
L3		Coil: #18x2Tx4.2.
L4		Coil: #18x3Tx6.2.
L5		Coil: #20x2.5Tx6.
L8		Coil: 9T, ID=4mm.
L10		Coil: 9T, ID=4mm.
L11		Coil: #19x7Tx5.
L12		Coil: 9T, ID=4mm.
L13		Coil: #20x6Tx4.
L14 and L15		Coil: #19x7Tx5.
L16 and L17		Coil: 9T, ID=4mm.
L18		Surface mount inductor: 56 nH.

SYMBOL	PART NUMBER	DESCRIPTION
----- TRANSISTORS -----		
Q1	N29/20954000030	Power amplifier driver, NPN: 2.5A, 18 V, MRF262.
Q2	N29/20954000020	Power amplifier, NPN: 6A, 18 V, SD1428.
----- RESISTORS -----		
R1 and R2		Carbon film: 330 ohms, 1/4 w.
R3	19B801251P822	Surface mount: 8.2K ohms, 1/10 w.
R7	19B801251P510	Surface mount: 51 ohms, 1/10 w.
R8	19B801251P103	Surface mount: 10K ohms, 1/10 w.
R16	19B801251P181	Surface mount: 180 ohms, 1/10 w.
R17	19B801251P330	Surface mount: 33 ohms, 1/10 w.
R18	19B801251P181	Surface mount: 180 ohms, 1/10 w.
R19 and R20		Metal film: 10 ohms, 1/2 w.
R21 and R22		Metal film: 10 ohms, 2 w.
----- CABLES -----		
W1	N29/85154002210	Coax cable, 100 mm.
W2	N29/85154000702	Coax cable, 80 mm.
W3	N29/85154001671	2-wire cable assembly.
W6	N29/85154001660	Power cable assembly, pigtail.
----- MISCELLANEOUS -----		
	N29/85154001652	Power cable assembly, with fuses (completely external to the radio).
	N29/14900900021	Antenna connector, TNC, female.
	N29/18454000020	Bushing, strain relief. (Used with W6).
		Crystal pin insulator.
		Shield, shell.
		Partition.
		Screw: M2.6 x 8. (Quantity 12).
		Screw: M2.6 x 10. (Used with transistors Quantity 4).
		Heat sink.
		Grounding plate.



* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

POWER AMPLIFIER BOARD
N29/85154000930 148-174 MHz



LAST REF USED	REFS NOT USED
RESISTOR R23	R4-R6, R10-R15
CAPACITOR C30	C3, C6
TRANSISTOR Q2	--
DIODE D4	--
INDUCTOR L18	L2, L7, L9
CONNECTOR J13	J2, J4-J9, J12
FFRRIT --	--
DD --	--

- NOTES:
1. ALL RESISTORS ARE 1/10W, 5%, CHIP UNLESS OTHERWISE SPECIFIED.
 2. RESISTOR VALUES ARE IN OHMS.
 3. CAPACITOR VALUES ARE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
 4. ALL CAPACITORS ARE CHIP CAPACITOR, UNLESS OTHERWISE SPECIFIED.
 5. C11 IS AN UNCASED MICA CAPACITOR.
 6. R1 AND R2 ARE 1/4W LEAD RESISTOR.
 7. * MICA CAPACITOR
 8. ** AWG #19
 9. *** AWG #20

NOTE - RESISTOR VALUES ARE GIVEN USING THE FOLLOWING CONVENTION:

- 18R = 18 OHMS
- 4R7 = 4.7 OHMS
- 4K7 = 4.7K OHMS
- 7K87 = 7.87K OHMS