DANIELS™
ELECTRONICS LTD.

MT-3 RADIO SYSTEMS

25W AM POWER AMP
INSTRUCTION MANUAL
AMP-3
118 - 138 MHz

Covers Model: AMP-3A130-25-00

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Quality Assurance:

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Quality Manager	Signature	Date

NOTE:

The user's authority to operate this equipment could be revoked through any changes or modifications not expressly approved by Daniels Electronics Ltd.

The design of this equipment is subject to change due to continuous development. This equipment may incorporate minor changes in detail from the information contained in this manual.

RF Exposure Warning

This transmitting equipment conforms to SAR (Specific Absorption Rate) limits regarding exposure of human beings to radio frequency electromagnetic energy, as defined in the following national and international standards and guidelines:

1. Industry Canada Radio Standards Specification 102 (RSS-102), *Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields*;

2. Health Canada Safety Code 6, *Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz* [1];

3. United States Federal Communications Commission, Code of Federal Regulations; 47 CFR Part 1, § 1.1310 *Radiofrequency radiation exposure limits*; and

4. American National Standards Institute (ANSI) criteria for localized SAR in Section 4.2 of "*IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*"[2].

Notes:

A. The SAR limit for uncontrolled exposure of persons not classed as RF and microwave exposed workers (including the general public) for transmitter equipment operating below 10 GHz, as defined in the references above, is **2 W/m^2** (0.2 mW/cm^2).

B. This transmitting equipment is designed for use with an outdoor antenna with a characteristic antenna gain of **10 dBi**, typically mounted at a significant height above ground to provide for adequate signal coverage. To ensure that the general public is not exposed to a power density above the recommended limit of 2 W/m^2 (0.2 mW/cm^2), the equipment must be installed such that the following minimum safe distances from the antenna are maintained:

6.0 m (19.7 ft)	when configured with	25 W AM PA (at 90% modulation)
2.4 m (7.9 ft)	standalone (i.e. no PA)	4 W AM TX (at 90% modulation)

C. The following power density formula has been utilized in determining minimum safe distances:

$$S = \frac{PG}{4\pi R^2}$$

where: S = Power density (in appropriate units, e.g. W/m^2)
P = Power input to the Antenna (in appropriate units, e.g., W)
G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
R = Distance to the center of radiation of the antenna (appropriate units, e.g., m)

[1] Minister of Public Works and Government Services, Canada 1999, Cat. H46- 2/ 99- 237E, ISBN 0- 662- 28032- 6

[2] ANSI/IEEE C95.1–1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017

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1 GENERAL

1.1 Introduction

The AMP-3A130-25 provides the final stage of RF amplification and filtering for the AM amplifier AMP-3A130-25, 118 - 138 MHz family. The amplifier covers 118 - 138 MHz with continuously adjustable 10.0 to 25.0 W of output power.

The amplifier is packaged in the compact Eurostandard (5"h x 2.8"w x 7.5"d) housing, and is robustly designed for mountain top or transportable applications. The amplifier modules use high reliability components and each is accompanied with a complete operational test report on delivery.

1.2 Performance Specifications

Frequency:	118 to 138 MHz
Output Power:	10-25 Watts Continuous (set by VT-3A exciter)
Output Impedance:	50 Ω
Spurious & Harmonics:	≤ -80 dBc
Distortion	≤ 5% at 30% modulation ≤ 10% at 90% modulation @ 25ºC
Operating Voltage:	+24 to 32 Vdc (28.0 Vdc Nominal)
Transmit Current:	≤ 3.0 A @ 25W
Standby Current:	Mode 1 & 2: ≤ 2 mA (PTT or RF signal switched) Mode 3: ≤ 200 mA (Continuous)
Load Mismatch Protection:	20:1 VSWR at all phase angles
Thermal Protection:	Thermal interlock disables at 80ºC (175ºF)
Duty Cycle:	100%
Operating Temperature:	-30ºC to +60ºC (-40ºC to +60ºC Optional)
Operating Humidity:	Up to 95% R.H. @ 25ºC
Front Panel Indicators:	RF Power High VSWR Overload Over Temperature
Exciter	VT-3A130, 2.5W output for 25W
Industry Canada Approval:	TBA
FCC Approval:	TBA

1.3 Physical Specifications

RF Connectors:	Type N Standard		
Corrosion Prevention:	Anodized aluminum construction. Stainless steel hardware.		
Physical Dimensions:	Width:	Height:	Depth:
	14.2 cm (5.6")	13.1 cm (5.16")	19 cm (7.5")
Weight:	2.4 kg (5.5 lb)		

Features:

- Heavy Duty Aluminum Heatsink
- Thermal switched Fan (at +40˚C)
- Outputs of operating status signals:
  - -RF Power
  - - High VSWR

2 THEORY OF OPERATION

2.3 RF Amplifier Circuitry

2.4 Printed Circuit board Numbering Convention

To ease troubleshooting and maintenance procedures, Daniels Electronics Limited has adopted a printed circuit board (PCB) numbering convention in which the last two digits of the circuit board number represent the circuit board version. For example:

- PCB number 43-912010 indicates circuit board version 1.0;
- PCB number 50002-02 indicates circuit board version 2 (no decimal versions)

All PCB's manufactured by Daniels Electronics are identified by one of the above conventions.

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3 INSTALLATION AND SITE OPERATION

The AMP-3 RF power amplifier is approved for operation with the VT-3A130 exciter. A complete M3 subrack shipped directly from the factory is normally set to the appropriate options and output power calibration as requested by the customer. These units require no tuning.

For AMP-3 amplifiers shipped separately from the MT-3 racks, install as outlined:

1. Connect the output of the exciter to the input of the AMP-3 Amplifier with the cable provided.
2. Connect the PTT control signal from subrack to the PTT input of the power amplifier if the PTT activation mode is selected.
3. Connect the antenna system, key the transmitter and check the LED status indicators.

The LED indicators will only illuminate when the power amplifier is keyed and are defined as follows:

A. RF Power - indicates that a preset RF power level is present at the power amplifier output. The threshold level is internally adjustable for various RF output levels over the 10-25 watt range (factory set at 10 W.)

B. High VSWR – Alarm indicating that the load impedance mismatch is high. The threshold level is internally adjustable from 2:1 to infinite:1 (factory set at 3:1.)

C. Overload – (VSWR Overload Alarm) indicates that the RF load impedance mismatch is extremely high. Under this condition, the DC supply voltage (nominally +28.0 Vdc) to the PA is interrupted and the status is locked until the RF signal from the exciter is removed. The factory threshold level is set when the load terminal is open.

D. Over Temp - (Over Temperature Alarm) a thermostat control switch interrupts the DC supply voltage to the PA when the RF transistor body temperature exceeds 175 ˚F (80 ˚C). Utilizing circuit hysterisis, the thermostat will reset at 167 ˚F (75 ˚C).

The fan is activated automatically when the RF transistor body temperature reaches approximately +40^{O}C. The fan's operating temperature range is -20^{O}C to +60^{O}C. It will not operate when the ambient temperature is below -20^{O}C.

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4 AMPLIFIER ALIGNMENT

4.1 Recommended Test Equipment List

To align the transmitter the following test equipment is recommended:

M-2/M3 rack/system monitor
Power supply: regulated 28.0 volt DC @ 5 A
Wattmeter: (e.g. Bird 4421)
Spectrum Analyzer (e.g. IFR 7550)
Alignment Tool, Johanson type 8777
Daniels Extender Card, EC-48R or EC-48UK
SWR Meter, 50 W 200 MHz
Power pad 50 ohm splitter (e.g. Socal)
Dummy Load 50Ω /50W
Dummy Loads, 2:1 and 3:1, /50W
Current Meter (5A)
DC Voltmeter

Figure 1 RF Power Amplifier Board Alignment Locations

4.2 RF Amplifier Board Alignment

Refer to **Figure 1** for location of adjustment capacitors.

This procedure assumes the use of 2 separate subracks with the exciter transmitter in system A and the 25W power amplifier in system B.

1. Remove the top extrusion cover housing from the exciter, set the exciter frequency at 128MHz (channel number 1200) and install the exciter in the system A of the M-2 or M-3 subrack. Remove all receivers from the subrack assembly (this will facilitate calibration access).

2. Install the extender card in the designated location for the AMP3A130-25 Power Amplifier (System B). Connect the RF output of the exciter to the input of the power amplifier module and the output to a Communications Service Monitor.

3. Apply +13.8Vdc to the subrack system A and +28Vdc to the subrack system B, activate the exciter transmitter and the power amplifier.

4. Turn the power adjustment potentiometer R19 in the exciter to achieve approximate 25W RF output. R19 is labeled "RF Level" and is accessed through the bottom of the exciter transmitter amplifier case.

5. Monitor the RF power output and adjust C2, C3 and C10 on the RF power amplifier board for maximum output power and minimum current. Check that the RF output power is within 25W±1dBc (app. 20%) when the exciter frequency is set to 118, 128 and 138MHz (channel number 0000, 1200 and 2400). Note that C2 and C3 are more effective in adjusting the output "flatness" over frequency.

6. Apply 1k/-25dBm AF signal into the balanced input of the exciter and adjust the potentiometer R35 in the exciter to get 30% modulation. R35 is accessed through the bottom of the exciter transmitter amplifier case, labeled Audio Level. Increase the audio signal level to –8dBm, the modulation level should be 90±5% and the audio distortion should be below 10%. Adjust C10 on the RF power amplifier board for minimum audio distortion and maximum RF output power.

7. Confirm that the audio distortion is below 10% at 90% modulation and the RF output power is within 25W±1dB at 0% modulation when the exciter frequency is set to 118, 128 and 138MHz, respectively. Go back to step 4 if these specifications are not met.

Figure 2 Control Board Alignment Locations

4.3 Control Board Alignment

1. After completion of the amplifier alignment, using the RF Level potentiometer in the exciter, set the RF output of the power amplifier to 10 watts. LED1 (labeled RF Power) should be on, otherwise adjust pot R1 until LED1 is just visible. This threshold may be adjusted to any RF power output level for the AMP-3 (10 – 25W).

2. Disconnect the power amplifier RF output and terminate it with the 3:1 mismatch load. When activating the exciter, the LED2 (labeled High VSWR) should be on, otherwise adjust pot R19 until LED2 turns on.

3. Terminate the power amplifier RF output with a 50Ω load. LED2 should be off, if not, slightly turn the pot R19 counter-clockwise until the LED2 is off and check that LED2 turns on when the power amplifier RF output is terminated with the 3:1 mismatch load.

4. Disconnect the RF terminal on the load, so that the power amplifier load is open. Once the exciter is activated, verify that LED3 (labeled Overload) is on and the power amplifier has no RF output power. If this is not the case, shut down the exciter, adjust R18 and reactive the exciter. This confirms that antenna VSWR overload protection works properly.

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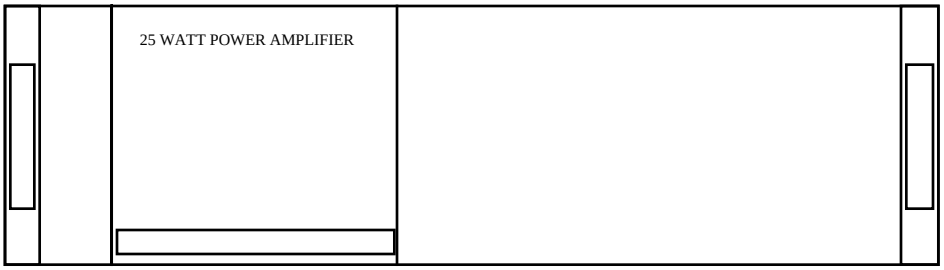
5 ILLUSTRATIONS AND SCHEMATIC DIAGRAMS

5.1 Rack Mounting Positions



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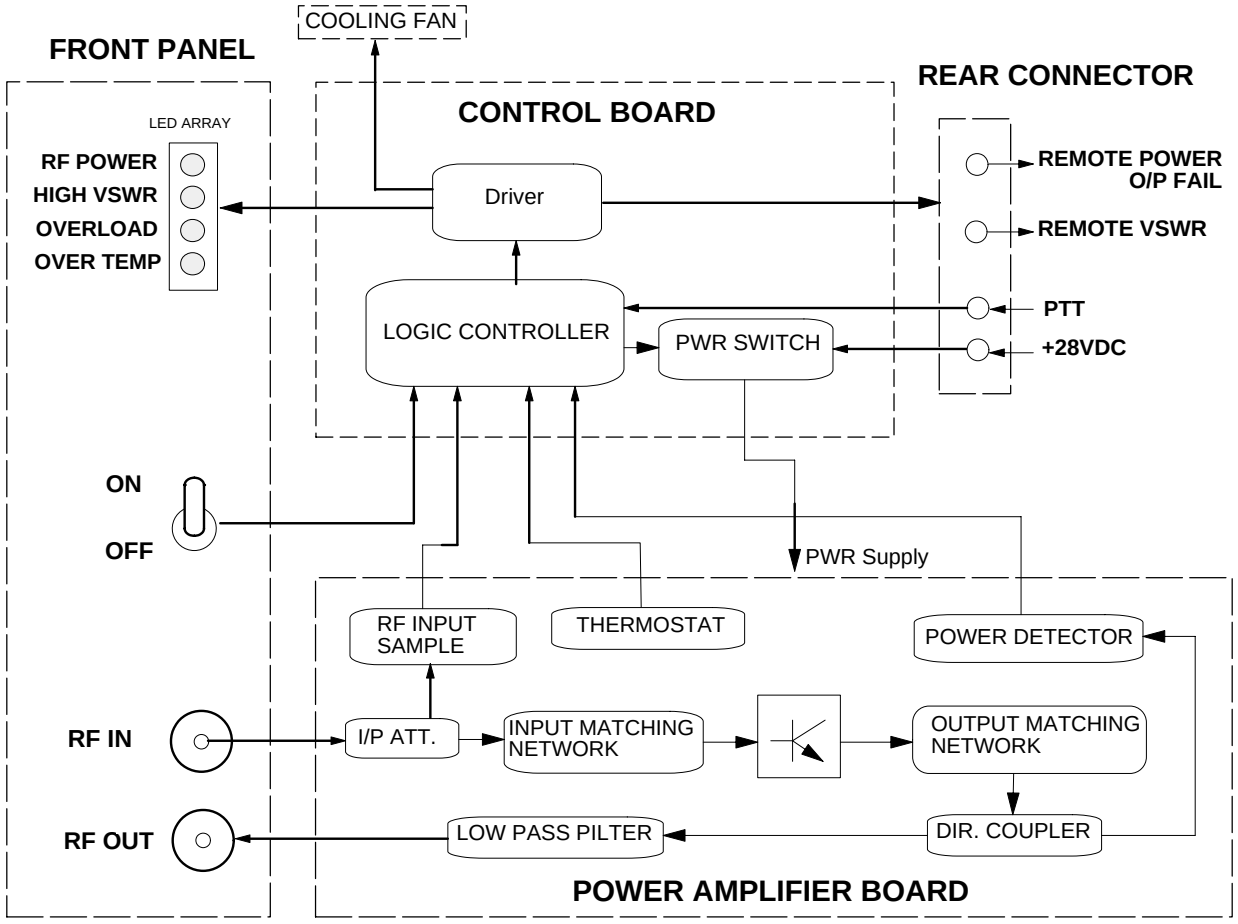
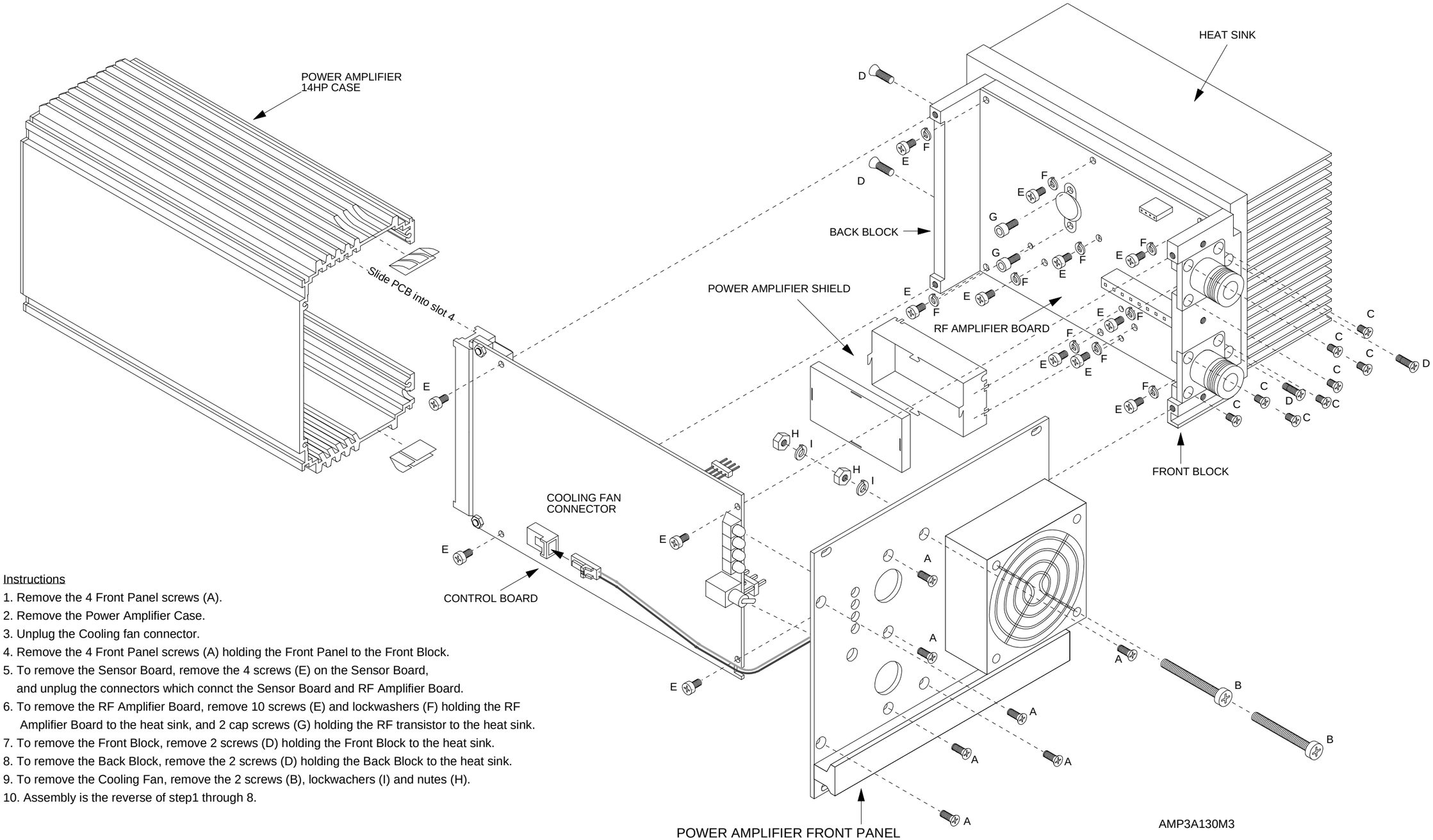
5.2 RF Power Amplifier Block Diagram



AMP3A130M2

5.3 POWER AMPLIFIER EXPLODED VIEW



Instructions

1. Remove the 4 Front Panel screws (A).
2. Remove the Power Amplifier Case.
3. Unplug the Cooling fan connector.
4. Remove the 4 Front Panel screws (A) holding the Front Panel to the Front Block.
5. To remove the Sensor Board, remove the 4 screws (E) on the Sensor Board, and unplug the connectors which connct the Sensor Board and RF Amplifier Board.
6. To remove the RF Amplifier Board, remove 10 screws (E) and lockwashers (F) holding the RF Amplifier Board to the heat sink, and 2 cap screws (G) holding the RF transistor to the heat sink.
7. To remove the Front Block, remove 2 screws (D) holding the Front Block to the heat sink.
8. To remove the Back Block, remove the 2 screws (D) holding the Back Block to the heat sink.
9. To remove the Cooling Fan, remove the 2 screws (B), lockwachers (I) and nutes (H).
10. Assembly is the reverse of step1 through 8.

5.4 RF Power Amplifier Board - Component Layout

5.5 25W AM Power AMP RF Amplifier Board Schematic

5.6 Control Board - Component Layout

5.7 25W AM Power Amp Control Board Schematic

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6 PARTS LISTS

6.1 RF Power Amplifier Board Electrical Parts List

Ref Desig	Description	Part No.

Ref Desig	Description	Part No.

Ref Desig	Description	Part No.

6.2 RF Power Amplifier Board Mechanical Parts List

Description	Part No.	Qty.
BACK BLOCK, DWG NO. 10596-02	TBA	1
CAP SCREW, M3x8 HEX SOCK-M2.5	5816-3M0SH08S	2
FRONT BLOCK, DWG NO. 10595-02	TBA	1
HEAT SINK, DWG NO. 10594-03	TBA	1
LID, LPF SHIELD, DWG NO. 10601-01	TBA	1
LOCKWASHER, M3, SPLIT, A2 STEEL	5814-3M0LK00S	10
PVB,	TBA	1
SCREW, M3 x 8, PAN/PHIL, A2	5812-3M0PP08S	10
SCREW, M3 x 10, FLAT/PHIL, A2	TBA	4
SCREW, M3 x 6, FLAT/PHIL, A2	5812-3M0FP06S	8
WALL, LPF SHIELD, DWG NO. 10600-01	TBA	1
TAB, GROUND, M3,14.5mm L,BR/Ni, DWG 10067-01	3702-67802005	2

6.3 Control Board Electrical Parts List

Ref Desig	Description	Part No.

Ref Desig	Description	Part No.

Ref Desig	Description	Part No.

6.4 Control Board Mechanical Parts List

Description	Part No.	Qty.	Ref. Desig
FUSE CLIP, RIVET MOUNT	TBA	2	
PA FRONT PANEL, DWG 10582-03	TBA	1	
HANDLE/NAMEPLATE KIT, 28HP, GREY	TBA	1	
FAN, 12VDC, 60X60X25mm, 20CFM	TBA	1	
	M33455-16, NIDEC		
CONN., .100", CRIMP HOUSING, 2CCT	TBA	1	
	50-57-9402, MOLEX	1	
TERMINAL, CRIMP, FEM., 22-24,Au	5021-TF22B002	1	
GUARD, FOR 60mm SQ. FAN, STEEL	6519-60602R0S	1	
TUBING, TFE-260C, 8AWG T/W, CLR	7610-260C08TW	8.5"	
FUSE, 8 AMP FAST-BLO	5604-5GAGC080	1	F1
CASE, 14HP RF PLUG-IN, MT-3 PA	TBA	1	
	DWG 10581-03		
GASKET, BeCu, 3FINGER, 71",CLIP	5630-12023250	1	
SCREW, M4 X 35, PAN/PHIL., A2	5812-4M0PP35S	2	
LOCKWASHER, M4, SPLIT,A2 STEEL	5814-4M0LK00S	2	
NUT, M4, HEX, 6.9mm FLATS, A2	5813-4M0HX69S	2	
NUT, PRESS,M2.5, 5.6mmOD, PC MNT	5833-T2M55615	2	
SCREW, M3 x 8,OVAL C/S/PHIL,A2	5812-3M0VP08S	7	
SCREW, M3 x 8, PAN/PHIL, A2	5812-3M0PP08S	4	
SCREW, M2.5 x 10 PAN/PHIL, A2	5812-2M5PP10S	2	

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7 REVISION HISTORY

Issue[i]	Issued	Revised	Details
1	July 2002		First Issue

[i] When a revision letter is assigned, it indicates that a revised issue has been released for in-house distribution only.

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