# MAINTENANCE MANUAL
# 136-174 MHz, 110 WATT POWER AMPLIFIER
# 19D902797G1

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## DESCRIPTION

The VHF Power Amplifier Assembly is a wide band RF power amplifier operating over the entire 136 to 174 MHz range without tuning or band splitting. Its main function is to amplify the 10 mW FM signal from the Transmitter Synthesizer to the rated RF output of 110 watts at the antenna port. The output of the Power Amplifier Assembly is adjustable from 65 to 135 watts at the PA output J104. This corresponds to a rated RF output of 55 to 110 watts at the antenna.

The assembly consists of a printed wiring board (A1) and associated components, including a power module and three RF power transistors, mounted to the heat sink assembly. The printed wiring board (A1) contains both the power amplifier circuitry (100 series components) and the power control circuitry (200 series components).

Unfiltered supply voltage, A+, for the power amplifier circuits enters the assembly via feedthrough capacitor, C1. Power cable W4 routes the A+ from CI to J103 on the PWB. Filtered A+ voltage for the power control circuit enters the assembly via control cable W13 which connects to the PWB at J201.

The Power Control circuitry sets the output power level by adjusting the PA Power Set level. It keeps the output power constant despite variations in input power, power amplifier gain, or temperature through the use of a feedback control loop in the PA assembly.

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| TABLE 1 - GENERAL SPECIFICATIONS | |
|---|---|
| **ITEM** | **SPECIFICATION** |
| FREQUENCY | 136 MHz - 174 MHz |
| OUTPUT POWER | 65 watts - 135 watts (into Low Pass Filter) |
| INPUT POWER (RF) | 10 mW min. into 2:1 VSWR |
| TEMPERATURE RANGE | 30°C TO + 60°C (Ambient air) |
| SUPPLY VOLTAGE | 13.4 Vdc |
| CURRENT | 29 Amps max. (25 A typical @ 135W, 13.4V) |
| DUTY CYCLE | Continous |
| STABILITY | Stable into 3:1 VSWR; all temp. ,voltage, freq. 65 watts - 135 watts |
| RUGGEDNESS AT HIGH VSWR | No damage into open or short load. |

# CIRCUIT ANALYSIS

## POWER AMPLIFIER

The power amplifier section of the PA Board consists of an Exciter, a Low Level Amplifier, a Driver, and the Power Amplifier Finals. All these gain stages have an input and output impedance of 50 ohms. Figure 1 is a block diagram showing the signal flow within the Power Amplifier Assembly.

**Exciter (UIOI)**

The Exciter stage uses a broadband silicon monolithic microwave integrated circuit (MMIC) amplifier. The signal from transmitter synthesizer, typically 10 dBm (10 mW), is input to the Exciter through a 10 dB resistive pad (R100R102). The Exciter amplifies the resulting 0 dBm (1 mW) signal to 20 dBm (100 mW). Following the Exciter is a 3 dB resistive pad (R104R106). This attenuatorreduces the MMIC output power to 17 dBm (50 mW).

The MMIC requires a 5 volt supply source. The 8 volt regulator (U100) provides the 5 volts to the MMIC via a dropping resistor R103.

**Low Level Amplifier (U1O2)**

The Low Level Amplifier (LLA) stage uses a 50 ohm thick film RF Power Module to amplify and control of the output power. Internally, the module is a two stage amplifier. The power control circuitry controls the gain of the first stage by varying the collector voltage of Q203. The second stage gain remains constant with A + providing the DC supply voltage.

The signal from the Exciter stage, typically 17 dBm (50 mW), is input into the LLA. Under maximum Power Set conditions, the LLA amplifies the signal to a typical output level of 40 dBm (10 W).

**Driver (Q101)**

The driver is a 6 dB RF amplifier. A network consisting of C114C117 and C139 and L103L105 provides interstage impedance matching between U102 and Q101. The signal from the LLA, typically 40 dBm (10 W), is amplified to 46 dBm (40 W). Impedance matching between the driver output and the input to U103 is provided by C145, C148, C152, C153, and L108. The splitter, U103, is a quadrature 90° hybrid coupler. It divides the signal and applies equal power to the two Power Amplifier Finals, Q102 and Q103.

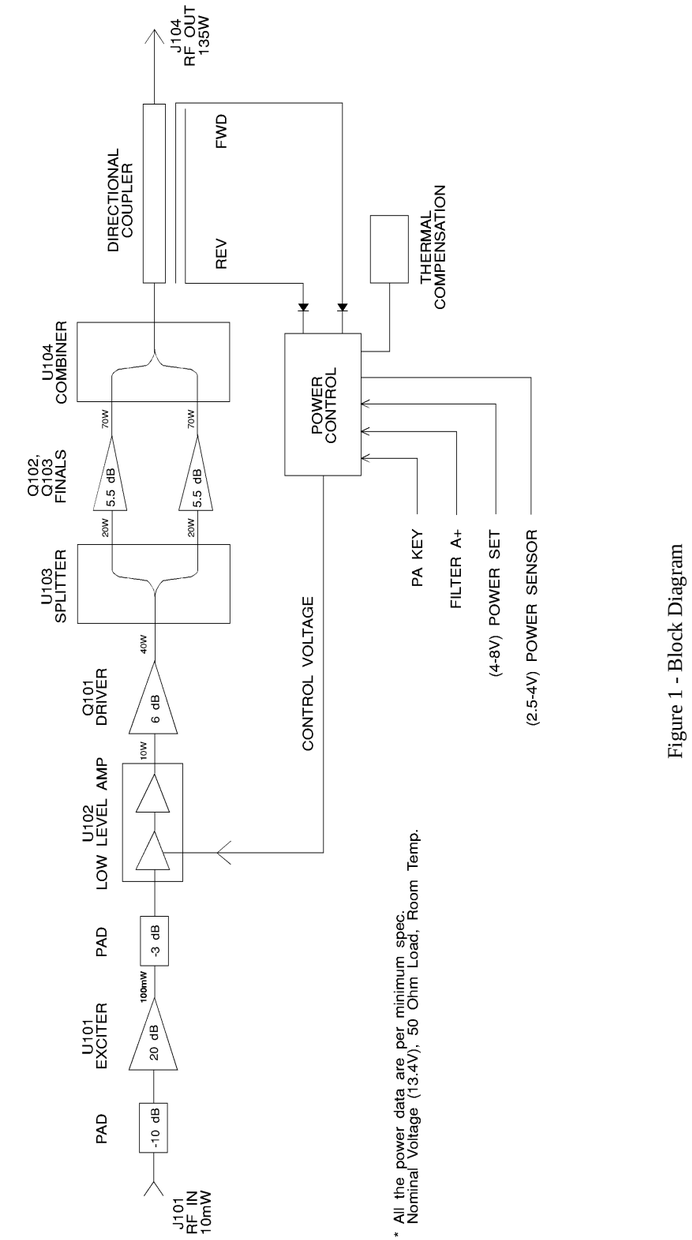



Figure 1 - Block Diagram

**Power Amplifier Finals (Q102, Q103)**

Each of the Power Amplifier Final devices is capable of producing 5.5 dB of gain. The output signal from the Splitter is impedance matched to each of the finals. Under optimum conditions each final amplifies the 43 dBm (20 W) power input signal to 48.45 dBm (70 W) output power. The outputs are then impedance matched to the input of the Combiner, U104. The Combiner is a quadrature 90° hybrid coupler which combines (sums) the output power of the finals. This produces an output power of approximately 51.3 dBm (135 W) which is coupled through C 140 to the directional coupler (part of A1 PWB) and on to the antenna circuits. In addition, the directional coupler samples both forward and reverse power and sends this sample to the Power Control circuitry.

## POWER CONTROL

The Power Control circuitry performs three basic functions. It keys and unkeys the PA, sets the PA output power, and protects the PA against adverse conditions.

**Keying and Unkeying the PA**

To key the PA, the digital controller places 5 volts on the PA key line, J201-2. Zero volts on the PA key line causes the PA to unkey. If the control cable (W13) is disconnected, with nothing actively driving the PA key line, the PA will remain unkeyed.

**PA Output Power Set**

PA output power is set according to the level of the Power Set line. Four (4) volts on this line will produce minimum power. As the voltage increases toward eight (8) volts, the power will increase to its maximum rated output. The PA output power is initially set for an output of 135 watts at J104. This is done by adjusting R217 while injecting a 10 mW signal at J1 and applying 8 volts to J201-3. After setting the maximum power level, changing the output power is done by varying the voltage applied on the Power Set line.

**PA Protection**

The power control also protects the PA against over temperature and high VSWR conditions.

An over temperature condition exists when the flange temperature of the final output transistor reaches 80°C. At this point the output power will drop below its set level. The output power will continue to drop such that when the flange temperature reaches 125°C the PA output drops at least 10 dB below its set level.

Reflected power is limited to 25% of the set power. If the output VSWR degrades to worse than 3:1 the forward power will be reduced to limit the reflected power to 25% of the set power. The Power Sensor line indicates when the PA is operating in a cutback condition. If the PA is keyed and the power control is cutting back, the Power Sensor line will drop to zero (0) volts and the PA alarm light on the station will turn on.

**Theory of Operation**

Power control of the MASTR III Power Amplifier is accomplished with a feedback control loop. The three possible feedback signals are: representation of forward power, temperature sensitive scaled representation of forward power, or representation of reflected power. These three signals are input to a diode summing junction which selects the largest of the three for use as the feedback.

The stripline directional coupler samples the output power and produces a voltage, Vf, proportional to the forward output power. The power control compares the forward voltage, Vf, to a reference voltage at U201D. The output of U201D controls the current flow thru Q202 and the output of Q203. The collector output of Q203 adjusts the control voltage, Vct1. This control voltage is capable of adjusting the total PA output power since it provides the first stage DC supply to the Low Level Amplifier, U102.

During over temperature operation, a scaled representation of the forward power is maintained constant by varying the control voltage line. Thermal resistor R209 sensing an increase in temperature causes the output of U201A to increase. If the output of U201A becomes larger than the other feedback lines, the output of U201D will begin to decrease. This in turn will cause the output of Q203 to decrease reducing the supply voltage to U102. Since the scaling is a function of temperature the power is reduced as the temperature increases.

Under VSWR cutback operation the reverse voltage, Vr, representative of the reflected output power is held below a threshold by reducing the control voltage as necessary. If Vr increases at U201B beyond the preset threshold an increase at U201D will result. This causes a subsequent reduction in the control voltage to U102. Thus the power control circuit reduces the output power in order to limit the reflected power to 25% of the set power.

**Signal Interface**

The signal interface to the MASTR III Power Amplifier is supported by a six position feedthrough connector, J201, with the following pinout:

1 - POWER SENSE
2 - PA Key
3 - POWER SET
4 - NC
5 - Ground
6 - 13.8 VF

**Power Sense**

This line indicates when the PA is experiencing adverse conditions. Under normal operation, while the PA is keyed, this line will be proportional to forward power. Minimum power (zero watts) corresponds to 2.5 volts while maximum power corresponds to 4.5 volts. This voltage is not temperature compensated and no effort is made to calibrate this signal to an absolute power level. It is intended to provide a relative indication of forward power and to discriminate between normal and cutback operation.

Zero volts on this line, when the PA is keyed, indicates the forward power is cutback. This power cutback may be due to high reflected power (VSWR) or may be due to high PA temperatures. This fault condition may indicate a problem with the PA or may indicate a system problem external to the Power Amplifier. High VSWR may be due to a poor antenna and high temperature may be due to a blocked cabinet vent. Zero volts on this line, when the PA is keyed, does not indicate zero forward power. Zero volts indicates the PA is protecting itself due to adverse conditions. If the adverse condition, either high VSWR or high temperature is eliminated, the power will return to normal and the PWR SENSOR voltage will rise above 2.5 volts.

**PA Key (Interface Connector pin 2)**

This line is used to key and unkey the PA. UNKEY = 0 volt and KEY = 5 volts. The driver of this line must be capable of supplying 5 volts at 1.0 mA. The appropriate key sequence requires RF from the transmit synthesizer be input to the PA before the KEY line is energized.

**Power Set (Interface Connector pin 3)**

This line is used to set the RF Power Output of the PA. Minimum power output equals 4 volts and maximum power output equals 8 volts. The driver of this line must be capable of supplying 8 volts at 1.0 mA.

**13.8 VF (Interface Connector pin 6)**

This line provides the filtered supply voltage for the Power Control. The driver of this line must be capable of supplying 13.8 volts ±20% at 100 mA.

## TROUBLESHOOTING GUIDE

| SYMPTOM | AREAS TO CHECK | INDICATIONS |
|---|---|---|
| 1. No Power or low Power at Antenna Port | 1. Measure the transmitter output power before the duplexer or antenna switch (for simplex mode). | The presence of power at this port is an indication of a defective duplexer, switch, or cables. |
| | 2. Measuer the transmitter output power before the low pass filter. | The presence of power at this port is an indication of a defective filter or cables. |
| | 3. Measure the transmitter output power before the optional isolator at the PA output port. | The presence of power at this port is an indication of a defective isolator or cables. |
| 2. No power at PA output port and PA ALARM is OFF | 1. Station is in receive mode. | |
| 3. No power at PA output port and PA ALARM is ON. | 1. No RF input to PA. Check connection between PA and TX Synthesizer. | TX Synthesizer should deliver a minimum of 10 mW (10 dBm) to the PA. |
| | 2. Check the logic or DC inputs to the PA from the Interface Board through J201. | |
| | a. J201-2 PA KEY | 5 volts during transmit |
| | b. J201-3 POWER SET | 4 volts to 8 volts (4 volts represents zero RF power) |
| | c. J201-6 13.8 VF | 13.8 Vdc ±20% |
| | 3. Defective PA | Replace PA |
| 4. Low power at PA output port and PA ALARM is OFF | 1. Low RF input to PA from TX Synthesizer. | Power should be a minimum of 10 mW (10 dBM). |
| | 2. Check the voltage on J201-3 (POWER SET). | For nominal output power, this voltage should be above 6 volts. |
| | 3. Check the power supply voltage on the collector of Q101, Q102 and Q103. | Voltage should be nominal 13.4 Vdc. |
| | 4. One of the two final PA transistors (Q102 or Q103 is defective. | Replace the defective transistor. |
| 5. Low power at PA output port and PA ALARM is ON. | 1. Check for over temperature and/or a high VSWR condition due to a mis-match at the output port. | The power control circuit protects the PA by cutting back the power. In case of a mismatch, refer to symptom 1. |

## VHF POWER AMPLIFIER VOLTAGE CHART

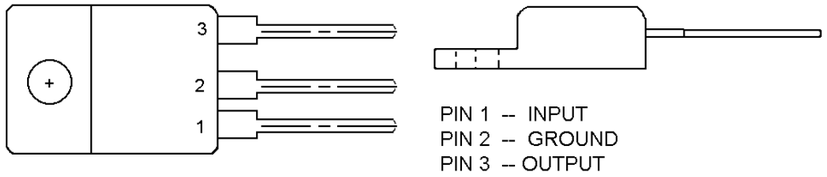
| PARAMETER (50 OHM, -30° TO +60° C) | REFERENCE SYMBOL | READINGS (volts DC) |
|---|---|---|
| SUPPLY VOLTAGE | A+ | 13.4 V ±20% |
| CONTROL VOLTAGE | Vct 1 | 0 - 12 V |
| FORWARD VOLTAGE | Vf | 3 - 7 V |
| REVERSE VOLTAGE | Vr | 2 - 6 V |
| POWER SENSE | J201-1 | 2.5 - 4 V |
| PA KEY | J201-2 | 5 V |
| POWER SET | J201-3 | 4 - 8 V |
| 13.8 VF | J201-6 | 13.8 V ±20% |

## VHF POWER AMPLIFIER TYPICAL VOLTAGE READINGS
## (50 ohm, room temperature, 13.4 Vdc supply voltage, and 110 watt output)

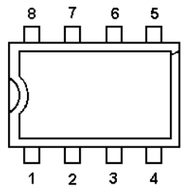
| REFERENCE SYMBOL | @ 136 MHz (volts DC) | @ 150 MHz (volts DC) | @ 162 MHz (volts DC) | @ 174 MHz (volts DC) |
|---|---|---|---|---|
| Vct1 | 7 - 10 V | 6 - 8 V | 4 - 6 V | 4 - 6 V |
| Vf | 5 - 7 V | 5 - 7 V | 5 - 7 V | 5 - 7 V |
| Vr | 2 - 3 V | 2 - 3 V | 2 - 3 V | 2 - 3 V |
| J201-1 | 2.5 - 4 V | 2.5 - 4 V | 2.5 - 4 V | 2.5 - 4 V |
| J201-3 | 6 - 8 V | 6 - 8 V | 6 - 8 V | 6 - 8 V |
| J201-6 | 13.4 V | 13.4 V | 13.4 V | 13.4 V |

## RATED POWER FOR MASTR III VHF BASE STATION

| STANDARD | WITH DUPLEXER | WITH ISOLATOR | WITH DUPLEXER AND ISOLATOR |
|---|---|---|---|
| 110W | 75W | 95W | 70W |

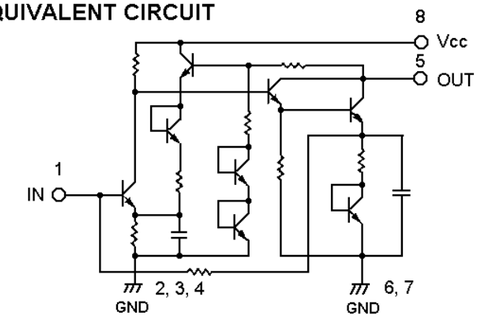



**U100**
**19A705532P2**
**VOLTAGE REGULATOR**




PIN CONNECTIONS
1. Input
2. GND
3. GND
4. GND
5. Output
6. GND
7. GND
8. Vcc

**EQUIVALENT CIRCUIT**




**U101**
**344A3221P1**
**MMIC AMPLIFIER**


1. P in
2. Vcc ı - 1ST STAGE
3. Vcc FINAL
4. P out
5. FIN - GROUND

**U102**
**19A70532P1**
**PA AMPLIFIER MODULE**

**110 WATT POWER AMPLIFIER**
**19D902797G1**
**ISSUE 3**

| SYMBOL | PART NO. | DESCRIPTION |
|---|---|---|
| | | ---------- ASSEMBLIES ---------- |
| A1 | | POWER AMPLIFIER BOARD 19D902794G1 |
| | | ---------- CAPACITORS ---------- |
| C100 and C101 | 19A702052P5 | Ceramic: 1000 pF ± 10%, 50 VDCW. |
| C103 | 19A702052P5 | Ceramic: 1000 pF ± 10%, 50 VDCW. |
| C104 and C105 | 19A705108P120 | Mica chip: 1000 pF, ±5%, 100 VDCW. |
| C106 | 19A705205P7 | Tantalum: 10 uF, 25 VDCW; sim to Sprague 293D. |
| C109 | 19A705205P7 | Tantalum: 10 uF, 25 VDCW; sim to Sprague 293D. |
| C110 | 19A705108P120 | Mica chip: 1000 pF, ±5%, 100 VDCW. |
| C111 and C112 | 19A705205P7 | Tantalum: 10 uF, 25 VDCW; sim to Sprague 293D. |
| C114 | 19A705108P19 | Mica: 18 pF, ±5%, 500 VDCW. |
| C115 | 19A705108P40 | Mica chip: 91 pF, ±5%, |
| C116 and C117 | 19A705108P95 | Capacitor, Mica Chip; 200 pF, + 5%, 100 VDCW, temp coef 0 ± 50 PPM. |
| C119 | 19A705108P22 | Mica: 24 pF, ±5%, 500 VDCW. |
| C123 | 19A705108P22 | Mica: 24 pF, ±5%, 500 VDCW. |
| C124 | 19A705108P30 | Mica: 51 pF, ±5%, 500 VDCW. |
| C125 | 19A705108P35 | Mica: 82 pF, ±5%, 500 VDCW, temp coef 0 ± 50 PPM/°C. |
| C126 | 19A705108P30 | Mica: 51 pF, ±5%, 500 VDCW. |
| C128 thru C130 | 19A705108P35 | Mica: 82 pF, ±5%, 500 VDCW, temp coef 0 ± 50 PPM/°C. |
| C131 and C132 | 19A700006P37 | Mica chip: 130 pF, ±5%, 100 VDCW. |
| C133 and C134 | 19A705108P120 | Mica chip: 1000 pF, ±5%, 100 VDCW. |
| C135 and C136 | 19A700006P37 | Mica chip: 130 pF, ±5%, 100 VDCW. |
| C137 and C138 | 19A705108P120 | Mica chip: 1000 pF, ±5%, 100 VDCW. |
| C139 | 19A705108P33 | Mica chip: 68 pF, ±5%, 100 VDCW. |
| C140 and C141 | 19A705108P120 | Mica chip: 1000 pF, ±5%, 100 VDCW. |
| C145 | 19A705108P25 | Mica chip: 33 pF, ±5%, 500 VDCW, temp coef 0 ± 50 PPM/°C. |
| C147 | 19A705108P120 | Mica chip: 1000 pF, ±5%, 100 VDCW. |
| C148 | 19A705108P36 | Capacitor, Mica Chip: 91 pF, + 5%, 500 VDCW, temp coef 0 ± 50 PPM. |
| C152 and C153 | 19A705108P35 | Mica: 82 pF, ±5%, 500 VDCW, temp coef 0 ± 50 PPM/°C. |
| C160 and C161 | 19A705108P30 | Mica: 51 pF, ±5%, 500 VDCW, temp coef 0 ± 50 PPM/°C. |
| C164 and C165 | 19A705108P22 | Mica: 24 pF, ±5%, 500 VDCW, temp coef 0 ± 50 PPM/°C. |
| C166 and C167 | 19A705108P27 | Mica: 39 pF, ±5%, 500 VDCW, temp coef 0 ± 50 PPM/°C. |
| C168 and C169 | 19A705108P120 | Mica chip: 1000 pF, ±5%, 100 VDCW. |
| C170 and C171 | 19A705205P7 | Tantalum: 10 uF, 25 VDCW; sim to Sprague 293D. |
| C201 | 19A702061P41 | Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM. |
| C202 and C203 | 19A702052P26 | Ceramic: 0.1 uF ± 10%, 50 VDCW. |
| C204 | 19A702061P41 | Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM. |
| C205 thru C207 | 19A702052P5 | Ceramic: 1000 pF + 10%, 50 VDCW. |
| C208 | 19A702052P26 | Ceramic: 0.1 uF ± 10%, 50 VDCW. |
| C209 | 19A702052P5 | Ceramic: 1000 pF + 10%, 50 VDCW. |
| C213 | 19A702052P26 | Ceramic: 0.1 uF ± 10%, 50 VDCW. |
| C225 | 19A702052P24 | Ceramic: 0.068 uF ± 10%, 50 VDCW. |
| C263 | 19A702052P5 | Ceramic: 1000 pF + 10%, 50 VDCW. |
| C266 | 19A702052P5 | Ceramic: 1000 pF + 10%, 50 VDCW. |
| C270 | 19A702052P5 | Ceramic: 1000 pF + 10%, 50 VDCW. |
| C272 and C273 | 19A702052P5 | Ceramic: 1000 pF + 10%, 50 VDCW. |
| | | ---------- DIODES ---------- |
| D201 and D202 | 19A700047P3 | 19A702250P113. |
| D203 | 19A700053P3 | Silicon: 2 Diodes in Series, Common Cathode; sim to MBAV70L. |
| D205 and D206 | 19A700053P3 | Silicon: 2 Diodes in Series, Common Cathode; sim to MBAV70L. |
| D209 | 19A700047P3 | 19A702250P113. |
| D210 | 19A700083P102 | Silicon: 5.1 Volt Zener; sim to SZSX84-C5V1. |
| | | ---------- JACKS ---------- |
| J101 | 19A705512P1 | Connector, RF SMB Series: sim to Amp No. 2211111-1. Printed wire, two part: 6 contacts, sim to Molex 22-29-2061. |
| J103 | 19A702778P464 | Threaded metalic spacer, swage type. |
| J201 | 19A704852P32 | Printed wire, two part: 6 contacts, sim to Molex 22-29-2061. |
| | | ---------- INDUCTORS ---------- |
| L100 | 19A701091G1 | Coil. |
| L101 | 19A701091G1 | Coil. |
| L102 | 19A129569P1 | Coil. |
| L103 | 19A701418P1 | Coil. |
| L104 | 19A701420P5 | Coil. |
| L105 | 19A701091G1 | Coil. |
| L106 | 19A701418P1 | Coil. |
| L108 | 19A701418P1 | Coil. |
| L115 | 19A701418P1 | Coil. |
| L116 | 19A701420P5 | Coil. |
| L117 | 19A701418P1 | Coil. |
| L118 | 19A701420P5 | Coil. |
| L119 and L120 | 19A129569P1 | Coil. |
| L121 and L122 | 19A701420P5 | Coil. |
| L123 and L124 | 19A701418P1 | Coil. |
| L125 and L126 | 19A129360P4 | Coil. |
| L160 and L161 | 344A3301P1 | Coil. |

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

| SYMBOL | PART NO. | DESCRIPTION |
|---|---|---|
| L203 thru L205 | 19A700024P37 | Coil, RF: 100 uH ± 10%. |
| | | ---------- TRANSISTORS ---------- |
| Q201 and Q202 | 19A700076P2 | Silicon, NPN: sim to MMBT3904, low profile. |
| | | ---------- RESISTORS ---------- |
| R100 | 19B800607P270 | Metal film: 27 ohms ± 5%, 1/8 w. |
| R101 | 19B800607P330 | Metal film: 33 ohms ± 5%, 1/8 w. |
| R102 | 19B800607P270 | Metal film: 27 ohms ± 5%, 1/8 w. |
| R103 | 19A700113P27 | Composition: 33 ohms ± 5%, 1/2 w. |
| R104 | 19B800607P331 | Metal film: 330 ohms ± 5%, 1/8 w. |
| R105 | 19B800607P100 | Metal film: 10 ohms ± 5%, 1/8 w. |
| R106 | 19B800607P331 | Metal film: 330 ohms ± 5%, 1/8 w. |
| R107 | 19A700113P5 | Composition: 3.9 ohms ± 5%, 1/2 w. |
| R109 | 19A700112P15 | Composition: 10 ohms ± 5%, 1 w. |
| R110 | 19A700112P13 | Composition: 8.2 ohms ± 5%, 1 w. |
| R112 | 19A700112P13 | Composition: 8.2 ohms ± 5%, 1 w. |
| R201 and R202 | 19B801486P101 | Metal film: 100 ohms ± 5%, 1/2 w. |
| R203 | 19B800607P103 | Metal film: 10K ohms ± 5%, 1/8 w. |
| R204 | 19B800607P183 | Metal film: 18K ohms ± 5%, 1/8 w. |
| R205 | 19B800607P223 | Metal film: 22K ohms ± 5%, 1/8 w. |
| R206 | 19B800607P103 | Metal film: 10K ohms ± 5%, 1/8 w. |
| R207 and R208 | 19A702931P301 | Metal film: 10K ohms ± 1%, 200 VDCW, 1/8 w. |
| R209 | 19A705813P2 | Thermistor: sim to AL03006-58.2K-97-G100. |
| R210 and R211 | 19B800607P472 | Metal film: 4.7K ohms ± 5%, 1/8 w. |
| R212 and R213 | 19A702931P301 | Metal film: 10K ohms ± 1%, 200 VDCW, 1/8 w. |
| R214 and R215 | 19B800607P103 | Metal film: 10K ohms ± 5%, 1/8 w. |
| R216 | 19B800607P102 | Metal film: 1K ohms ± 5%, 1/8 w. |
| R217 | 19A700109P5 | Variable, cermet: 10K ohms ± 20%, 1/4 w. |
| R218 and R219 | 19B801486P101 | Metal film: 100 ohms ± 5%, 1/2 w. |
| R220 | 19A702931P333 | Metal film: 21.5K ohms ± 1%, 200 VDCW, 1/8 w. |
| R221 | 19A702931P293 | Metal film: 9090 ohms ± 1%, 200 VDCW, 1/8 w. |
| R223 | 19B800607P102 | Metal film: 1K ohms ± 5%, 1/8 w. |
| R224 | 19B800607P103 | Metal film: 10K ohms ± 5%, 1/8 w. |
| R226 and R227 | 19B800607P103 | Metal film: 10K ohms ± 5%, 1/8 w. |
| R228 | 19B800607P102 | Metal film: 1K ohms ± 5%, 1/8 w. |
| R229 and R230 | 19B800607P103 | Metal film: 10K ohms ± 5%, 1/8 w. |
| R233 | 19B800607P103 | Metal film: 10K ohms ± 5%, 1/8 w. |
| R235 | 19B800607P103 | Metal film: 10K ohms ± 5%, 1/8 w. |
| | | ---------- INTEGRATED CIRCUITS ---------- |
| U101 | 344A3221P1 | Linear: MMIC Amplifier; sim to NEC UPC1677C. |
| U201 | 19A701789P4 | Linear: Quad Op Amp; sim to LM224D. |
| | | ---------- CAPACITORS ---------- |
| C1 | 19A116708P2 | Feedthru. |

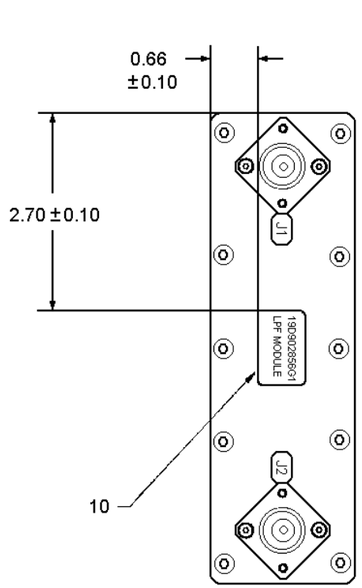
| SYMBOL | PART NO. | DESCRIPTION |
|---|---|---|
| | | ---------- JACKS ---------- |
| J1 | | Part of W1. |
| J104 | 7777145P5 | Receptacle: sim to Amphenol 82 - 97. |
| | | ---------- TRANSISTORS ---------- |
| Q101 | 19A134340P4 | Silicon, NPN, VHF Amplifier: 45 w. |
| Q102 and Q103 | 19A149632P1 | Silicon, NPN, VHF Amplifier: 68 w., 12.5 volts. |
| Q203 | 19A700055P1 | Silicon, PNP: Darlington; sim to TIP - 125. |
| | | ---------- RESISTORS ---------- |
| R108 | 19A143832P4 | Power: 50 ohms ± 5%, 150 w. |
| R111 | 19A143832P4 | Power: 50 ohms ± 5%, 150 w. |
| | | ---------- INTEGRATED CIRCUITS ---------- |
| U100 | 19A705532P2 | Integrated Circuit, Linear (Positive Voltage Regulator): sim to M57719. |
| U102 | 19A705326P1 | Power Amplifer Module: 145 to 175 MHz., sim to Mitsubishi M57719. |
| U103 and U104 | 344A3219P1 | Coupler, hybrid: 130 to 180 MHz, amplitude balance ±0.25 dB; sim to Anaren No. 10262 - 3. |
| | | ---------- CABLES ---------- |
| W1 | 19B801529G4 | RF Input Cable. Includes the following: |
| | 19B800560P2 | RF Cable. |
| | 19A705512P3 | Connector, RF SMB Series: sim to AMP 228213 - 1. |
| | 19A115938P1 | Connector, coaxial: (BNC Series); sim to Amphenol 31 - 318. |
| W4 | 19B801695G11 | Power Cable. Includes the following: |
| | 19B209268P115 | Solderless terminal. |
| | 19B209260P11 | Solderless terminal. |
| | 19A115959P2 | Wire, stranded. |
| | 19A701503P2 | Cable: battery, red. |
| | 19A701503P10 | Cable: battery, black. |
| | 19B209268P116 | Solderless terminal. |
| W10 | 19B801695G3 | Power Cable: W12 - R. |
| W11 | 19B801695G4 | Power Cable: W12 - BK. |
| W13 | 19B801739P1 | Power Control cable. |
| | | ---------- MISCELLANEOUS ---------- |
| 2 | 19D902420P6 | Heat sink assembly. |
| 5 | 19A702381P510 | Screw, thread forming: TORX DRIVE No. M3.5 - 0.6 x 10. |
| 6 | 7139898P3 | Nut, hex, brass: No. 1/4 - 28. |
| 11 | 19A702364P310 | Machine screw, TORX Drive: No. M3 - 0.5 x 10. |
| 15 | 7147306P2 | Insulator. |
| 16 | 19A700136P7 | Insulated sleeving. |
| 21 | 19A701863P27 | Clip, loop. |
| 22 | 19A701312P5 | Flatwasher: M3.5. |
| 28 | 19A702364P316 | Machine screw: Pan Head, Steel. |
| 29 | 19A700034P4 | Nut, hex: No. M3 x 0.5 MM. |
| 30 | 19A700033P5 | Lock washer, external tooth: No. 3. |
| 35 | 19A705469P1 | Insulator Plate, TO - 220. |
| 36 | 19A700068P1 | Insulator, bushing. |
| 37 | 19A134455P3 | Flatwasher. |
| 38 | 19B801659G3 | Cover (see separate parts list below). |
| 41 | 19A700033P6 | Lock washer, external tooth, M3.5. |
| 45 | N405P5B6 | Lock washer. |
| 46 | 19A701312P4 | Flatwasher: 3.2 ID. |
| 50 | 19A702381P408 | Tap screw, TORX Drive, M3 - 0.5 x 8. |
| 51 | 19A705106P1 | Resistor Spacer. |

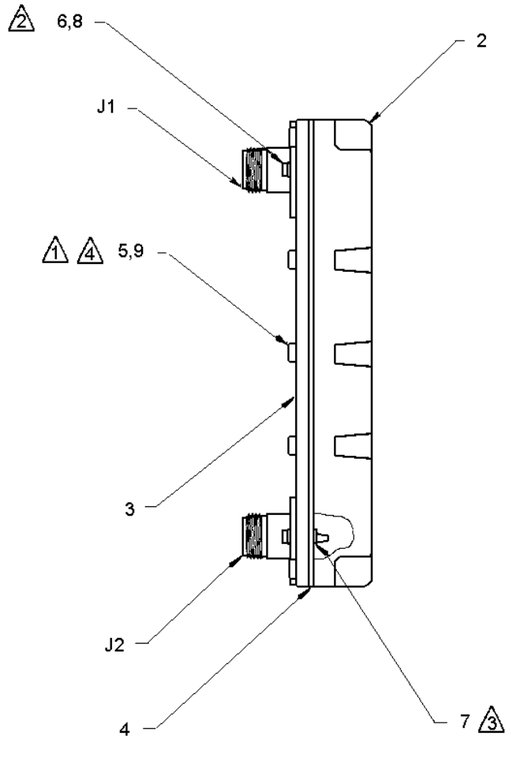
| SYMBOL | PART NO. | DESCRIPTION |
|---|---|---|
| | | COVER 19B801659G3 |
| 2 | 19D902421P1 | Power Amplifier Cover. |
| 4 | 19A702381P522 | Screw, thread forming: |
| 5 | 19A701365P4 | Washer. |
| 11 | 19A149969P3 | Shield. |
| 13 | 5493477P9 | Axial fan. |
| 14 | 5493477P10 | Grille. |
| 15 | N80P13028B6 | Machine screw. |
| 16 | N210P21B6 | Machine nut. |
| 17 | 19A701312P5 | Flatwasher: M3.5. |
| 18 | 19A701863P10 | Clip, loop. |
| 20 | 19A702364P410 | Machine screw. |
| 21 | 19A700041P28 | Shell. |
| 22 | 19A700041P26 | Contact: sim to Molex 08 - 50 - 0113. |
| 24 | N405P37B6 | Lock washer. |
| 25 | L401P23B6 | Split washer. |

**LOW PASS FILTER MODULE**
**19D902856G1**
**ISSUE 1**

| SYMBOL | PART NO. | DESCRIPTION |
|---|---|---|
| | | ---------- JACKS ---------- |
| J1 and J2 | 7777145P5 | Receptacle: sim to Amphenol 82 - 97. |
| | | ---------- MISCELLANEOUS ---------- |
| 2 | 19D903063P1 | Casting. |
| 3 | 19D903064P1 | Casting. |
| 4 | 19D902853G1 | High Band Filter Board. See separate parts list. |
| 5 | 19A702381P513 | Screw, thread forming: TORX, No. M3.5 - 0.6 x 13. |
| 6 | 19A702364P210 | Machine screw, metric: M2.5 - .45 x 10. |
| 7 | 19A134455P3 | Flatwasher. |
| 8 | 19A700032P3 | Lockwasher, tooth, steel, metric: 2.5. |
| 10 | 19B235310P1 | Nameplate. |
| | | HIGH BAND FILTER BOARD 19D902853G1 |
| | | ---------- CAPACITORS ---------- |
| C301 | 19A116679P6R2D | 6.2 pF. |
| C302 | 19A116679P24G | 24 pF. |
| C303 | 19A116795P33G | 33 pF. |
| C304 | 19A116679P3R9D | 3.9 pF. |
| C305 | 19A116679P68J | 68 pF. |
| | | ---------- INDUCTORS ---------- |
| L301 | 19A129569P1 | Coil. |
| L302 | 19A701418P1 | Coil. |
| L303 | 19A129569P1 | Coil. |
| L304 | 19A701420P5 | Coil. |
| L305 | 19A129569P1 | Coil. |
| L306 | 19A701418P1 | Coil. |

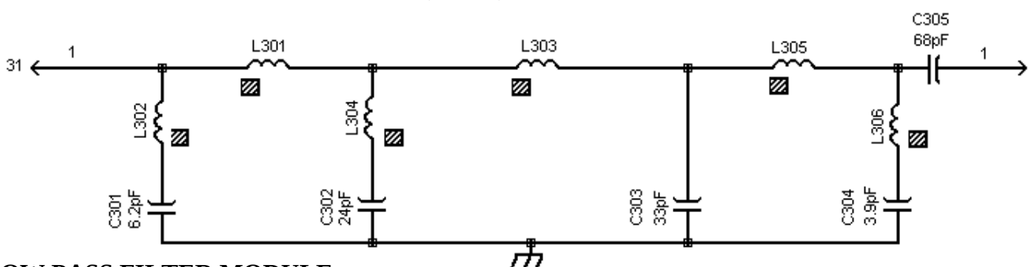
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



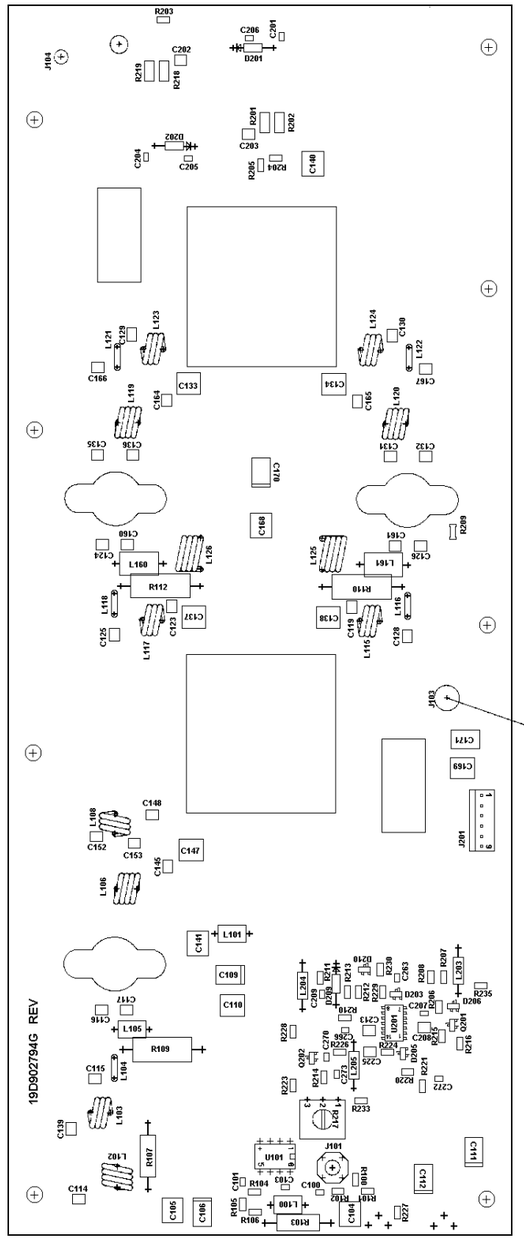

NOTES:

1. TORQUE SCREW, ITEM 5, TO 15.5 1.3 IN - LB.
2. TORQUE SCREW, ITEM 7, TO 7 IN - LBS.
3. SOLDER CONNECTORS J1 AND J2 AND ITEM 7 TO ITEM 4.
4. COAT THREADS OF SCREW, ITEM 5, WITH LUBRICANT, ITEM 9, BEFORE INSTALLING.



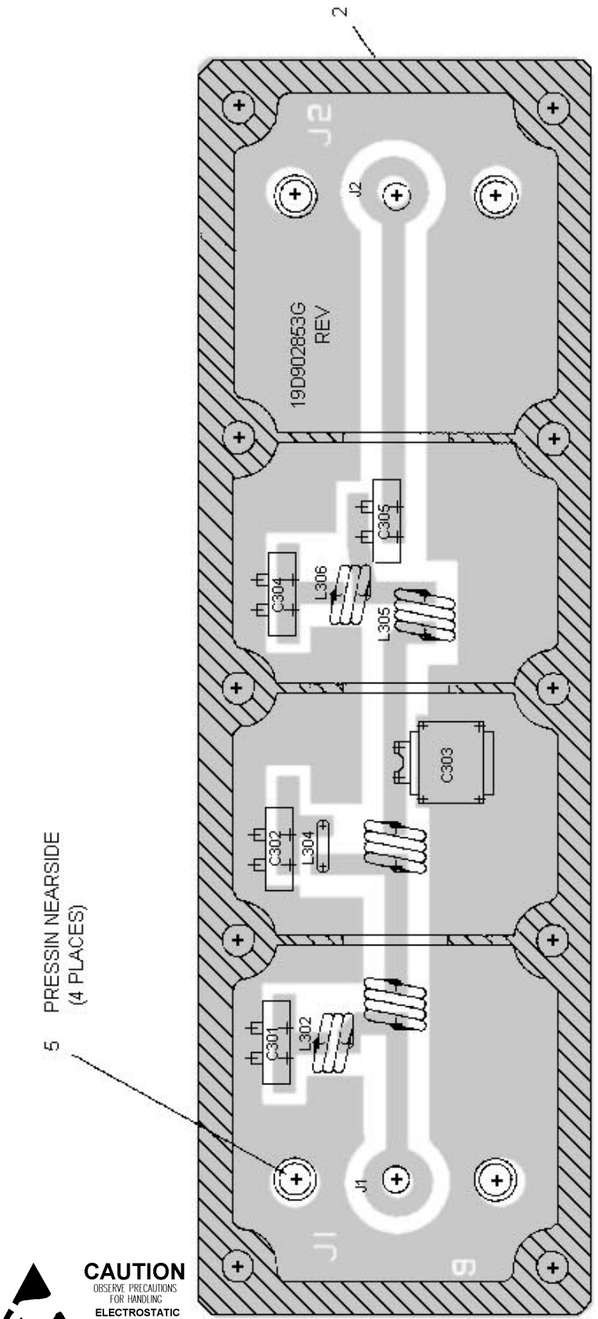

**LOW PASS FILTER MODULE**
**19D902856G1**

(19D902856 Sh. 1, Rev. 0)
(19D902855, Sh. 1, Rev. 1)




**POWER AMPLIFIED BOARD A1**
**19D902794G1**

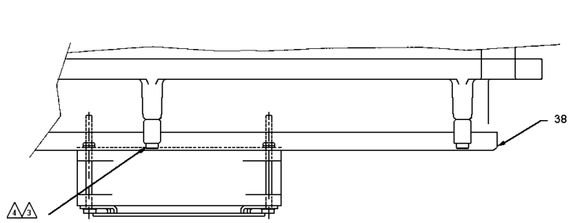
(19D902794, Sh.1, Rev. 12)




CAUTION
OBSERVE PRECAUTIONS FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES

**LOW PASS FILTER MODULE**
**19D902856G1**

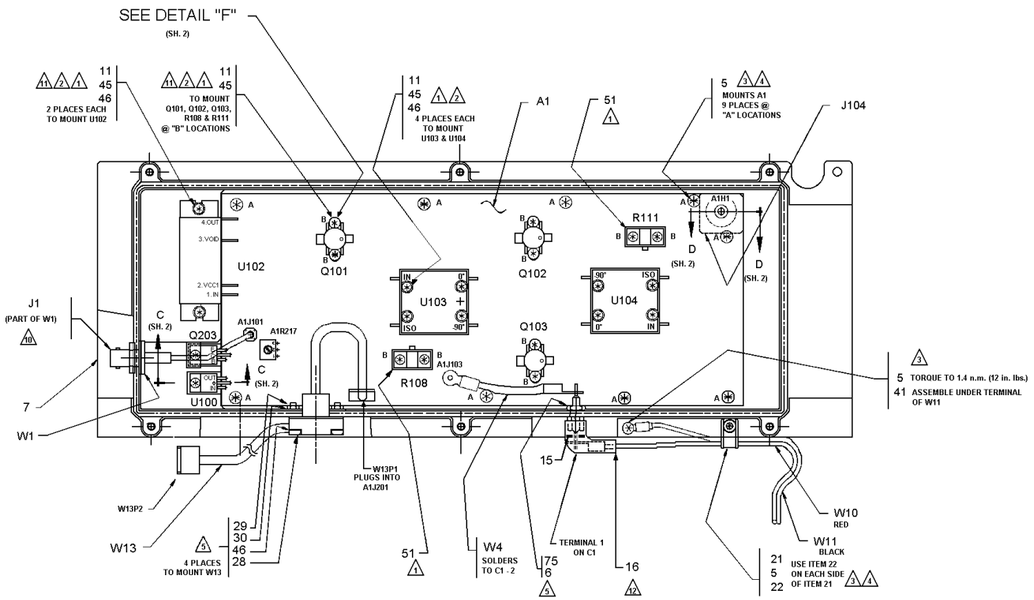
(19D902853, Sh.1, Rev. 2)
(19D902854, Comp. Side, Rev. 9)



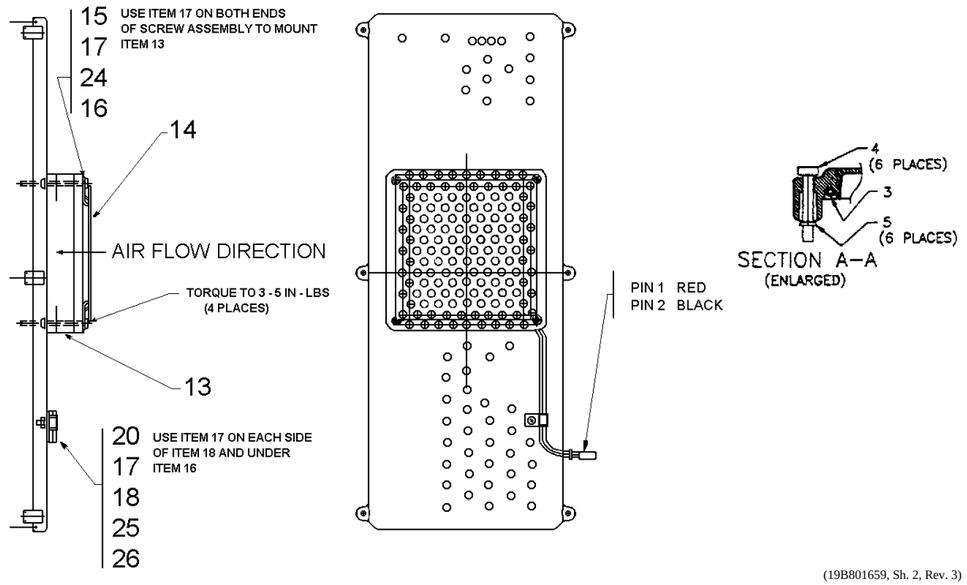

(1)

NOTES:

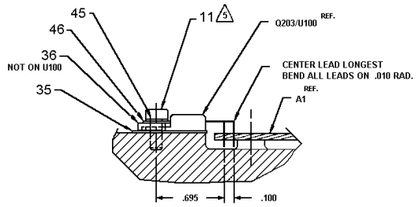
1. APPLY SILICONE GREASE BETWEEN THE HEAT SINK, ITEM 7 AND THE MOUNTING SURFACES OF: Q101, Q102, Q103, U102, U103, & U104 TOP & BOTTOM SURFACES OF ITEM 51.
2. RECOMMENDED ASSEMBLY PROCEDURE: (..... TIGHTEN MOUNTING HARDWARE, TORQUE TO 0.6 N.m. (6IN. lbs.)
3. LUBRICATE HARDWARE BEFORE ASSEMBLY USING ITEM 10
4. TORQUE HARDWARE TO 1.1N.m (10 in. lbs.)
5. TORQUE HARDWARE TO 0.6N.m (6 in. lbs.)
10. USE HARDWARE SUPPLIED WITH COMPONENT, TORQUE TO 0.6 N.m (6 in. lbs.)
11. CARE MUST BE USED IN SOLDERING LEADS OF Q101, Q102, Q103, R108, R111, & U102 TO BOARD, (A1) TO AVOID SHORTING SOLDER TABS TOGETHER.
12. TERMINATE W10 BY SOLDERING TO C1 - 1. SLEEVE ENTIRE ELECTRICAL CONNECTION WITH SLEEVING, ITEM 16.

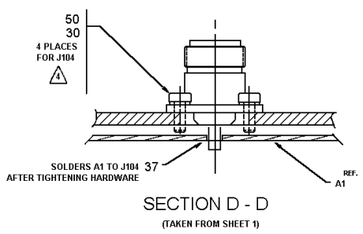


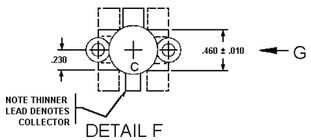

**POWER AMPLIFIER ASSEMBLY**
**19D902797G1**
(19D902797, Sh. 1, Rev. 10)

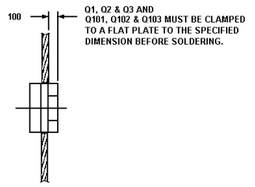



(19B801659, Sh. 2, Rev. 3)




**POWER AMPLIFIER ASSEMBLY**
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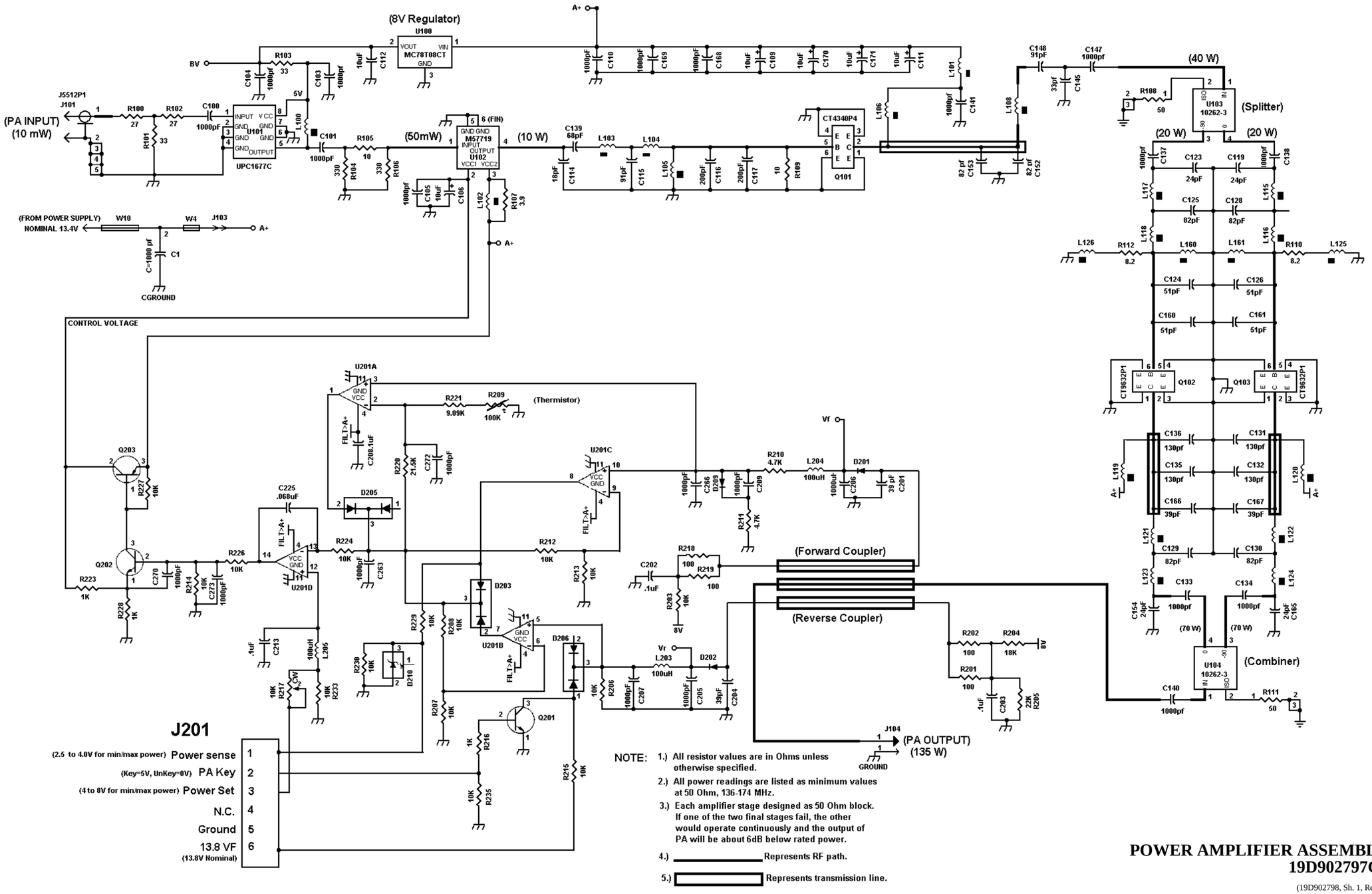
(19D902797, Sh. 2, Rev. 10)




**POWER AMPLIFIER ASSEMBLY**
**19D902797G1**

(19D902798, Sh. 1, Rev. 3)