MOTOROLA

SMR
6868

Manual Revision

QUANTAR™ Instruction Manual for: *Quantar* ™ Digital-Capable Station for Conventional, *SECURENET*, ASTRO®, 6809 Trunking, and *IntelliRepeater* Systems

This SMR applies to manual revision 68P81095E05-D, Power Amplifier Module section 68P81086E23-B, behind the “Transmitter Circuitry” tab. The changes described in this SMR will be included in the next update of the manual. This revision contains information on new Power Amplifier Modules released since the manual was printed in March 2004.

The 125W VHF Power Amplifier Module models TLD3101G and TLD3102G have been replaced by new 125W VHF Power Amplifier Module models CLD1298A and CLD1299A, respectively. The new modules are functionally identical to the assemblies they replace.

The TLD3101G and TLD3102G modules are no longer available and have been replaced by the CLD1298A and CLD1299A modules.

Replace section 68P81086E23-B behind the “Transmitter Circuitry” tab in your manual with the attached new section 68P81086E23-C.

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POWER AMPLIFIER MODULE

MODELS: TLD3110A (25W, 132 - 174 MHz)
CLD1298 (125W, 132 - 154 MHz)
CLD1299 (125W, 150 - 174 MHz)

1 DESCRIPTION

The Models TLD3110 and CLD1298/CLD1299 Power Amplifier Modules are described in this section. A general description, identification of controls, indicators, and inputs/outputs, functional block diagrams, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Power Amplifier Module (PA) accepts a low-level modulated rf signal from the Exciter Module and amplifies the signal for transmission via the site transmit antenna. The output power is continually monitored and regulated by a feedback and control loop, with a power output control voltage being generated by the transmitter control circuitry located in the Exciter Module.

The Models TLD3110 and CLD1298/CLD1299 PA Modules are very similar in design and function, with the major differences being the output power capabilities and operating frequency range. Unless otherwise noted, the information provided in this section applies to all three models.

Overview of Circuitry

The PA contains the following circuitry:

- Intermediate Power Amplifier (IPA) – contained in 25W PA only. Low-level amplifier stage which is controlled by the transmitter control voltage from the Exciter Module; provides an output of approximately 0 to 10W
- Driver Power Amplifier (DPA) – contained in 25W PA only, provides final amplification of the IPA output; provides an output of 35W maximum
- Final Power Amplifier (FPA) – contained in 125W PA only, provides final amplification of the exciter output; provides an output of 160W maximum. All the rf amplifying transistors are included on this final module.

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- Circulator – provides PA module output isolation
- Harmonic Filter/Coupler – suppresses harmonic radiation and couples the PA output to the transmit antenna connector; also serves as a power meter
- Sense and Detect Circuitry – provides sense and detect signals for critical signal points throughout the circuitry; signals are monitored by the Exciter Module

2 CONTROLS, INDICATORS, AND INPUTS/OUTPUTS

Figure 1 shows the PA controls, indicators, and all input and output external connections.

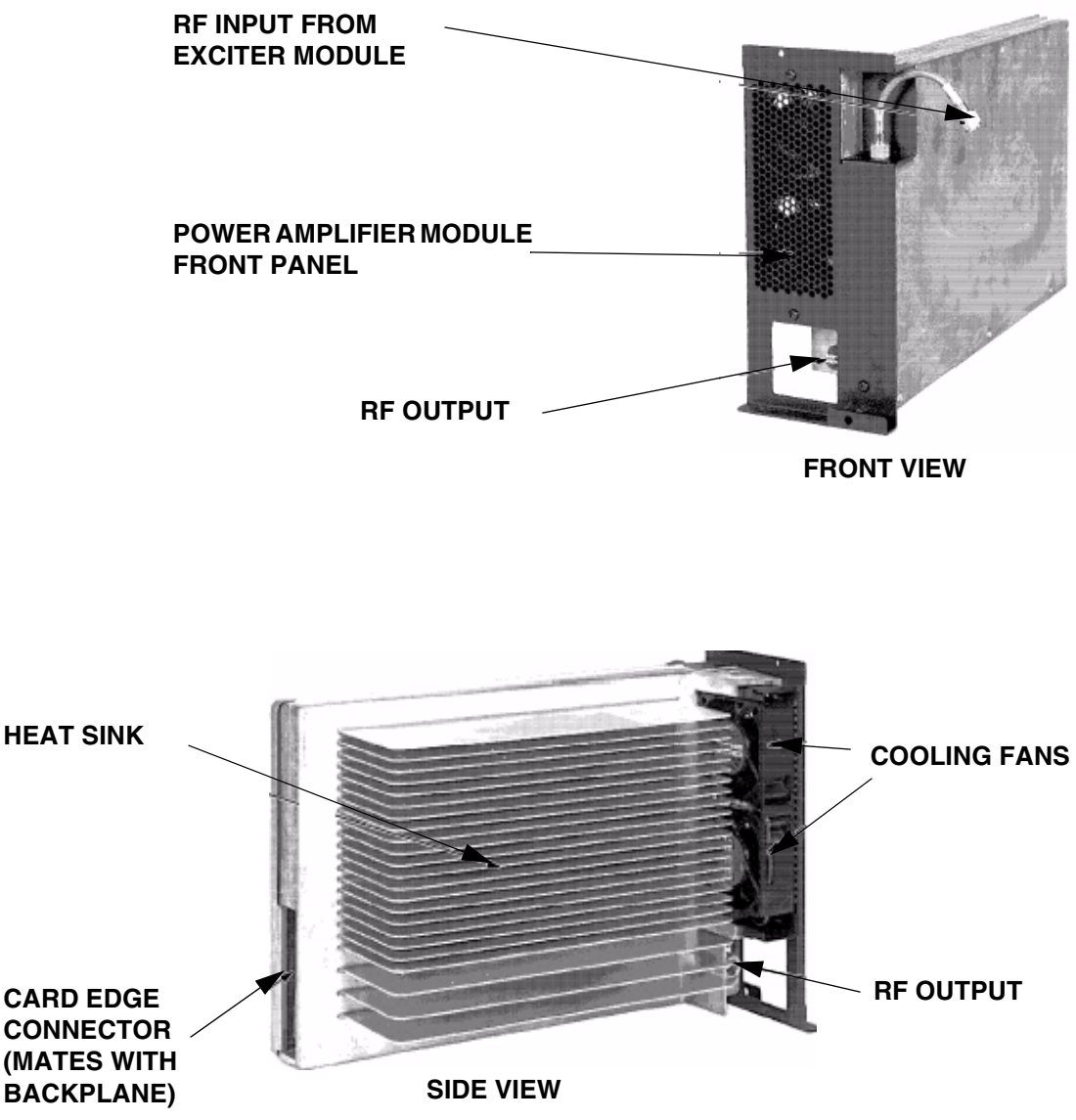

Figure 1 Power Amplifier Module Controls, Indicators, and Inputs/Outputs (125 W Model Shown)

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the PA circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Functional block diagrams are provided in Figure 2 (TLD3110, 25 W) and Figure 3 (CLD1298/CLD1299, 125 W). As mentioned previously, the three PA modules are similar in design and function. The following theory of operation applies to all four modules except where noted.

RF Signal Path

A low-level modulated rf signal (approximately +13 dBm) from the Exciter module is input to the PA module via a coax cable. For the 25W PA, the signal is input to the IPA and amplified to approximately 0 to 10W [depending on the dc power control voltage (V-CONT) from the Exciter Module]. The IPA output is fed to a DPA (25W), where final amplification occurs. The output of the DPA (35W maximum) is fed to a circulator, which passes the transmit signal to the harmonic filter/coupler, while routing all reflected power to a 50Ω load.

For the 125W PA, the exciter output signal is fed to the Final Module and is amplified up to 160W [depending on the dc power control voltage (V_CONT) from the Exciter Module] The output of the Final Module is fed to a circulator.

The output of the circulator is fed to the harmonic filter/coupler. This circuit provides highly selective bandpass filtering and couples the signal to an N-type connector mounted to the module casting. A coax cable routes the signal to an N-type connector mounted on an rf input/output connector bracket located on the rear of the station.

Output Power Control

A feedback and control loop configuration is used to regulate the PA output power. The Harmonic Filter/Coupler generates a dc voltage proportional to the PA Module output power. This voltage (TX_VF) is fed to the TX Power Control Circuitry in the Exciter Module. The TX_VF voltage is compared to reference voltages to generate a dc power control voltage (V_CONT).

Note: *V_OMNI does not control the output level of the DPA directly, but serves as on/off control for the DPA stage.*

The dc power control voltage (V_CONT) is output from the Exciter Module and fed through filtering circuitry in the PA to a voltage translation and current limiting circuit. The output of this circuitry is V_OMNI, a dc voltage which controls the output power of the IPA.

Summary of Power Control Operation

25W—By controlling the output level of the IPA (range of 0 to 10W), the output power of the PA module is established. The feedback and control loop (TX_VF fed back to Exciter Module resulting in V_CONT to control IPA output) continually monitors and maintains the proper output power from the PA.

125W—The output power of the PA is established by controlling the gain of the first two stages of the three-stage Final Module. Here also, the feedback and control loop continually monitors and maintains the proper output power for the PA.

Sense and Detect Circuitry

Introduction

The PA is equipped with several sense and detect circuits to provide status signals to the Exciter Module. In most cases, the Exciter Module microprocessor uses these signals to determine PA operating conditions and, in response, varies certain control signals to correct output power, turn on cooling fans, etc. The sense and detect circuits are described in the following paragraphs.

Current Sensing Circuitry (25W)

IPA and DPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the IPA and the DPA and outputs two dc signals directly proportional to the IPA and DPA currents. Circuit operation is described in the following paragraph.

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltage (IPA_I or DPA_I) is fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the IPA or DPA.

Current Sensing Circuitry (125 W)

FPA current sense circuitry (comprised of two differential amplifiers and two sensing resistors) meters the current being drawn by the FPA (side A and side B) and outputs two dc signals directly proportional to the currents for side A and side B. Circuit operation is described in the following paragraph.

Sense and Detect Circuitry (Continued)

In each of the current sense circuits, a differential amplifier measures the voltage drop across a sensing resistor and outputs a dc voltage directly proportional to the current through the resistor. The dc voltages (FPA_I1_A and FPA_I1_B) are fed to the Exciter Module (via an analog multiplexer and filtering circuitry) where it is used in calculating the current being drawn by the FPA (side A or side B).

PA Temperature Sense

A thermistor and buffer circuit provides a dc voltage proportional to the PA temperature. This signal (PA_TEMP) is fed to the Exciter Module, which monitors the signal and reduces the PA output power [by reducing the dc power control voltage (V_CONT)] if the PA temperature exceeds set limits.

IPA, DPA, and FPA Detect Circuitry

Detection circuits provide a dc voltage approximately proportional to the rf outputs of the IPA, DPA (25W), and FPA (125W) stages. These dc signals (IPA_VF, DPA_VF, and FPA_VF, used for diagnostic purposes only) are fed to the Exciter Module via an analog multiplexer and filter circuitry.

Reflected Power Detect Circuitry

The Harmonic Filter/Coupler provides a dc voltage approximately proportional to the reflected power at the output of the stage. This dc signal (TX_VR) is fed to the Exciter Module via an analog multiplexer and filter circuitry. The signal indicates the amount of potentially harmful reflected power at the PA output. If the reflected power exceeds a set limit, the Exciter Module will shut down the PA.

V_OMNI Detect Circuitry

A voltage divider circuit provides a dc voltage approximately proportional to the V_OMNI control voltage from the Voltage Translator & Current Limiter circuit. This dc signal (V_OMNI*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

+74V Detect Circuitry

A voltage divider circuit provides a dc voltage approximately proportional to the +14V dc input voltage from the station Power Supply Module. This dc signal (1 4.2V_REF*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

+28V Detect Circuitry (125W Only)

A voltage divider circuit provides a dc voltage approximately proportional to the +28 V dc input voltage from the station Power Supply Module. This dc signal (28V_REF*) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

Cooling Fans Control Circuitry (125 W Models Only)

The cooling fans in the PA Module are thermostatically controlled and may come on at any time during station operation. Keep fingers clear of fan blades.

The PA is equipped with a dual fan module to provide forced air cooling of the PA. The fan module is controlled by a FAN ON signal from the Exciter Module, which is fed to a driver circuit in the PA Module. The Fan Driver/Detect Circuitry controls the power to the fans via two feed-thru pins in the PA chassis which mate with the power connector on the slide-in fan module. The fans are turned on only when the temperature in the PA exceeds a set limit. It is normal for the fans to cycle on and off during station operation.

The Fan Driver/Detect Circuitry also monitors the current to the fans and feeds a dc detect voltage to the Fan Status Circuitry, which outputs a status signal indicating whether the fan current is above or below a predetermined range. The status signal (FAN_ALARM) is fed to the Exciter Module via an analog multiplexer and filter circuitry.

Power Amplifier ID Resistor ROM

A resistor network read-only memory (ROM) provides power amplifier ID information to the Exciter Module via an analog multiplexer and filter circuits. This information includes the band and range in which the PA is designed to operate (e.g., VHF-Range 1, UHF, 900 MHz, etc.) and the maximum output power (e.g., 25 W, 125 W, etc.).

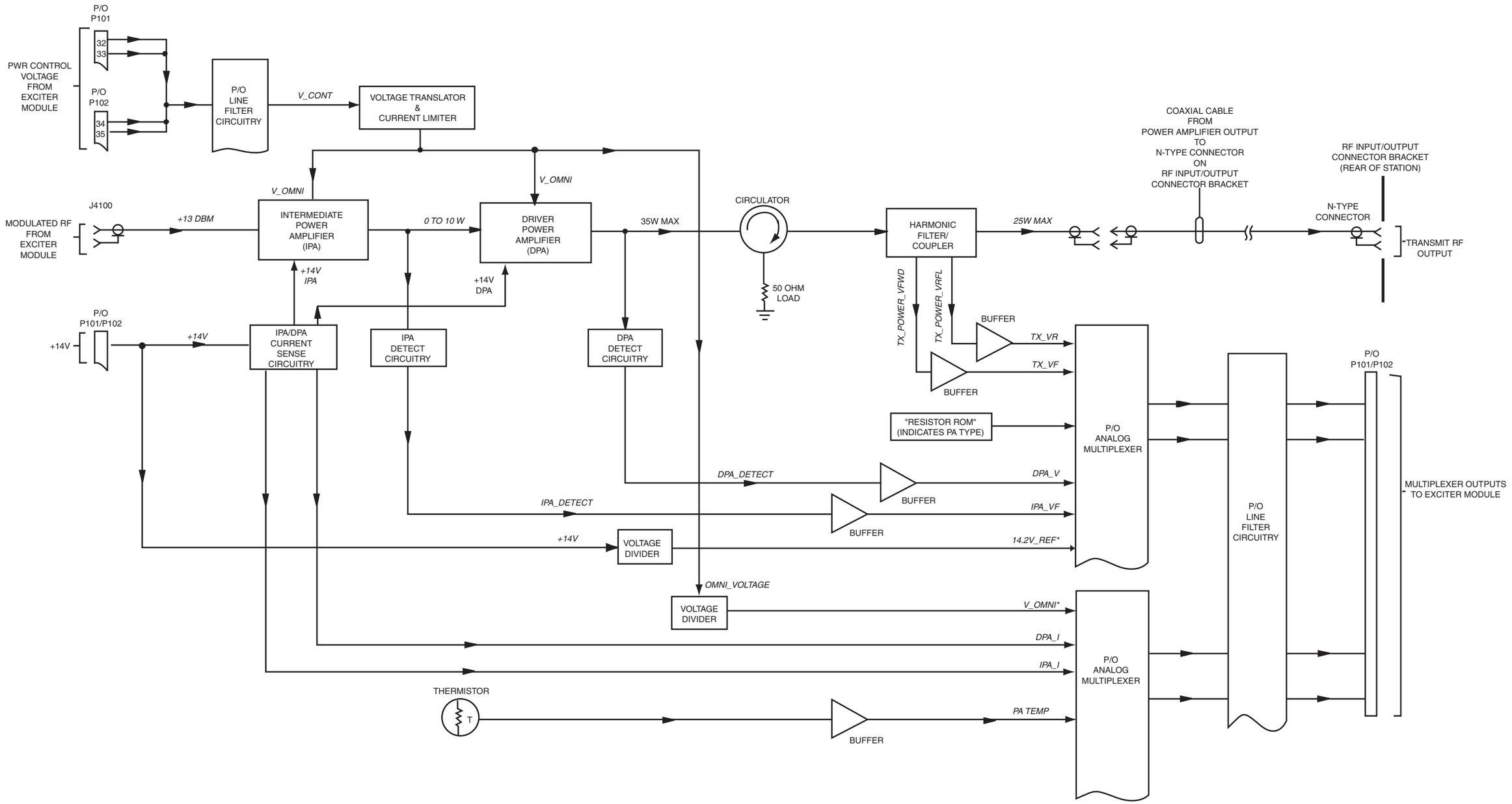

Figure 2 TLD3110 25W Power Amplifier Module Functional Block Diagram

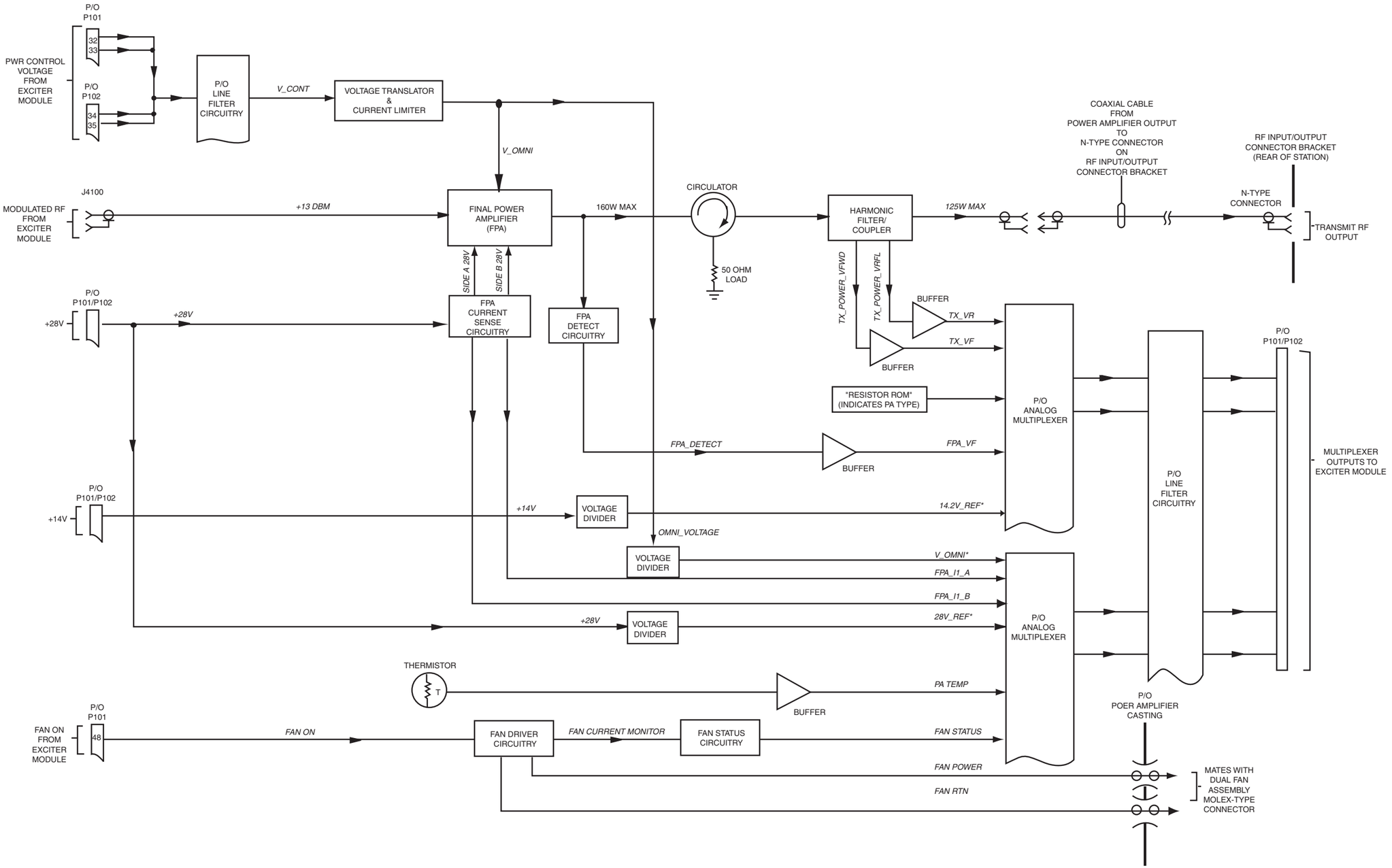

Figure 3 CLD129A8/CLD1299A 125W Power Amplifier Module Functional Block Diagram