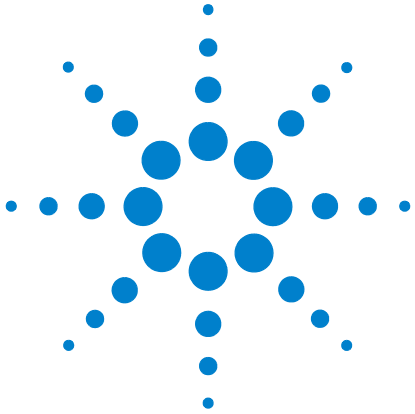

Agilent 200- to 600-MHz High-Band, High-Power Amplifier

Installation, Operation, and Maintenance

Agilent Technologies

Notices

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CAUTION

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WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Contents

Introduction and Description

WARNING **High voltages are present in this system. Always turn the power off before making any connections between the amplifier components. Do not defeat the safety interlocks in this system. For further information consult the Glassman manual included with the shipment.**

This manual contains information on the Agilent CMA series RF Power amplifier systems. The principal function of this manual is to provide you with information and guidance for inspection, installation, operation, troubleshooting, and maintenance of the CMA series of RF Power amplifiers. For the purposes of this manual, this final stage is defined as the Low Voltage supply p/n M099045901, the Glassman High Voltage supply p/n M190716400, and the RF deck p/n M806625xxx. (The xxx denotes frequency.)

Unless otherwise specified in text, this manual applies to all M806625xxx model numbers (xxx applies to 200 to 600 MHz models).

Product description

The CMA series amplifier is designed specifically for NMR/NMR imaging applications. This amplifier series incorporates a Grounded Grid Power Triode Vacuum Tube design that operates in class AB, Class C, or Gate Active modes. Class AB is typically used for transmitting functions. Class C is preferred for noise blanking during reception. However, class C mode is capable of amplification and finds use in certain solids applications. The gate active mode allows a TTL signal input to control biasing of the Grounded Grid Triode amplifier. This RF amplifier provides a gain range of 10 to 14 dB over the frequency range of 200 to 600 MHz in class AB. The output power range is 800 to 1000 watts at the CMA RF output connector depending on frequency.

Functional description

The CMA series amplifier has four major sections of operation, the **Input Match** section, the **Output Match** section, the **Control** section, and the **Gating** section.

The **Input Match** section is a tunable circuit designed to optimize performance across the desired band for maximum

gain and minimum distortion. The variable tuning circuit consists of two variable capacitors in circuit with fixed inductors and fixed capacitors that are connected to adjustment knobs on the front panel, thus allowing the user to adjust the input (in conjunction with output adjustment) for maximum output of the amplifier.

The **Output Match** section is a tunable circuit designed to optimize performance across the desired band for maximum gain and minimum distortion. The variable tuning circuit consists of two variable capacitors in circuit with fixed inductors and fixed capacitors that are connected to adjustment knobs on the front panel, thus allowing the user to adjust the output (in conjunction with input adjustment) for maximum output of the amplifier.

The **Control** section incorporates a Control/Gating Select board that is used to protect the power tube from RF overloads, due to a mismatched output section, which can destroy the sensitive tube grid. It also provides safety features to prevent dangerous electric high voltage shocks when the chassis covers are removed and the high voltage supply is not shut off. The absence of forced airflow also shuts off the tube supply and RF input. The Gating Mode Select board is used to select the bias modes, Class AB, Class C, and Gate Active, depending on the experiment desired. The **Control** section also incorporates a lockout condition that forces the Gating Bias Select board into Class A/B mode. A logic high signal (+5.0 Vdc) applied to J33 pins 6 (supply) and 7 (rtn) through connector P7703 on the high voltage return cable, causes the Gating Select board to switch to Class A/B. Neither the bias voltage nor the class LED will respond to changes in the bias select switch setting while a logic high signal is applied to the Gating Select board through the connector.

The plate current measurement on the front panel is measured with high impedance, in Vdc on an oscilloscope. The control board has an op amp that amplifies the voltage reading from a current sense resistor by 100. This reading is the plate to cathode current reading. The maximum plate current is 1.2 A (12 V at the plate current connector on the front panel) pulsed.

The grid current measurement on the front panel is measured with high impedance, in Vdc on an oscilloscope. The control board has an op amp that amplifies the voltage reading from a current sense resistor by 50. This reading is the grid current reading. The maximum grid current reading is 150 mA. (-7.5 V at the grid current connector on the front panel). At this current reading the amplifier will shut off and go into an RF overload

state. This reading is set at the Trip Adj potentiometer on the front panel. The adjustment reference is measured at the Trip Ref connector on the front panel.

The **Gating** section incorporates a gating box circuit that switches the cathode from an on state or class AB bias of approximately positive 8 Vdc to an off state or class C bias of about positive 26 Vdc which is sufficiently high above the grounded grid to drive the tube into complete cutoff in the absence of an input RF signal. Two control signal inputs are provided, gated and class AB. A logic high control signal at the class AB input to the gating box will provide an on state or approximately 8 Vdc to the cathode. Inside the Gating box there is a selection jumper at J4 on the circuit board that allows the TTL signal input to represent a positive or a negative blanking control. Depending on the position of this jumper, the logic high control signal at the gated input will provide an on state 8 Vdc at the cathode, or an off state 26 Vdc at the cathode. The jumper position of pins 1 to 2 reflects a negative blanking condition, thus with no logic high signal input at the TTL input connector and the gated control signal high, the output of the gating box will be in an off state 26 Vdc at the cathode. The jumper position of pins 2 to 3 reflects a positive blanking condition, thus with no logic high signal input at the TTL input connector and the gated control signal high, the output of the gating box will be in an on state 8 Vdc at the cathode.

Connectors, Knobs, and LED's

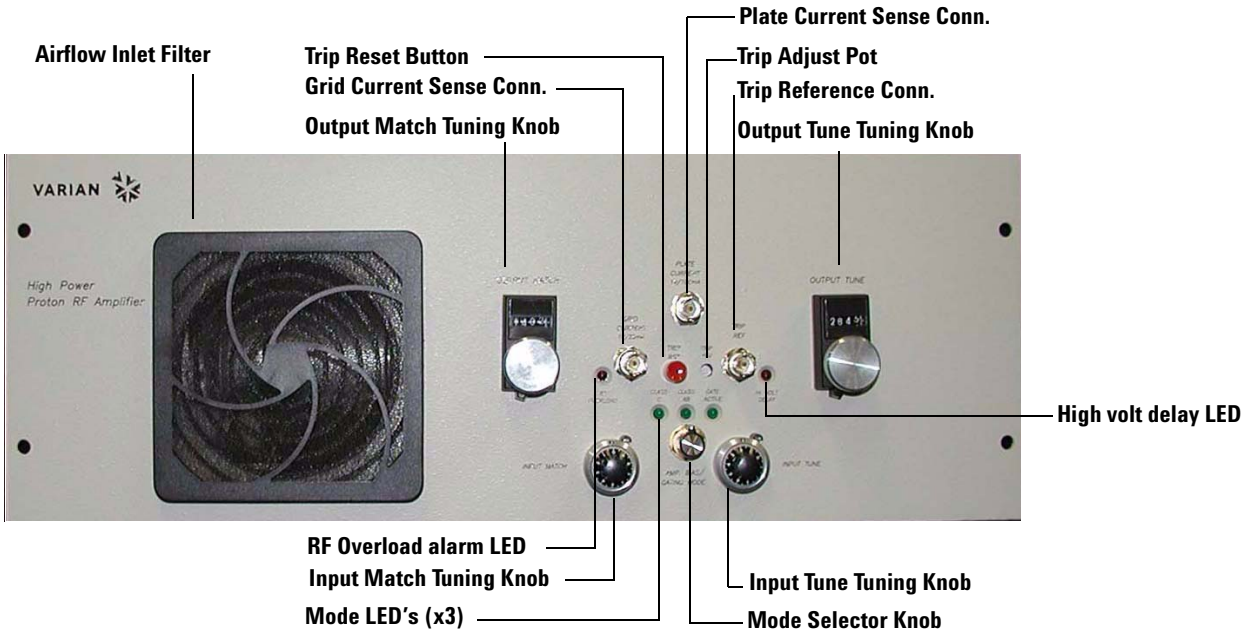


Figure 1 CMA RF deck front panel

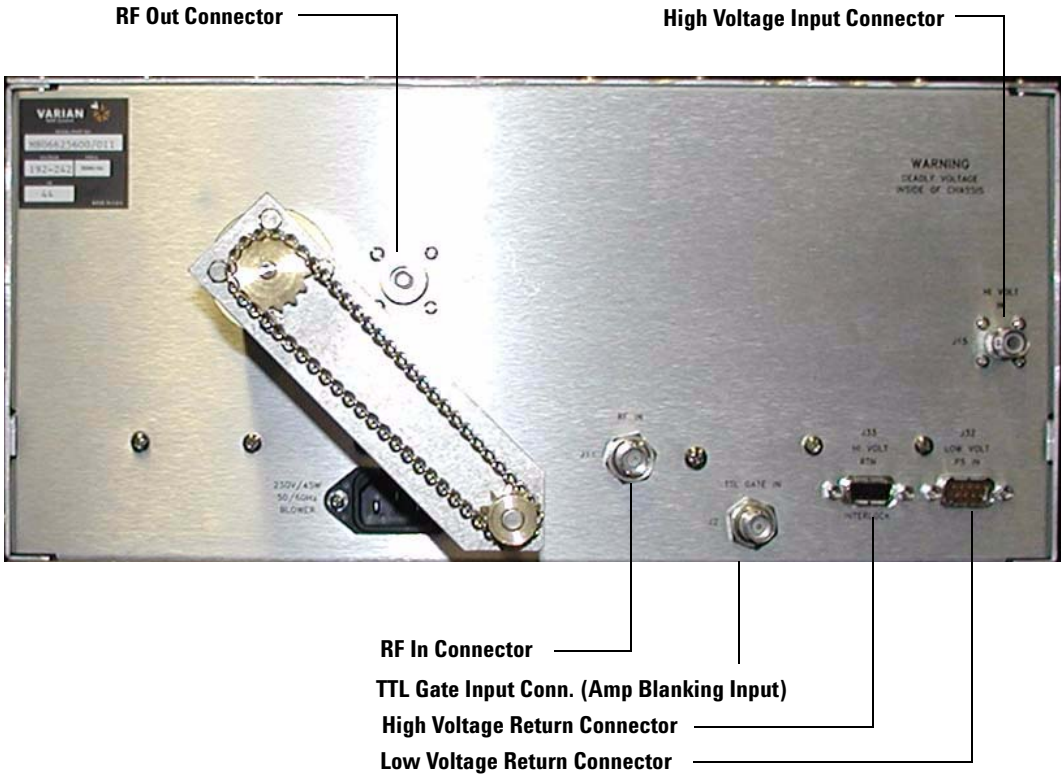


Figure 2 CMA RF deck rear panel

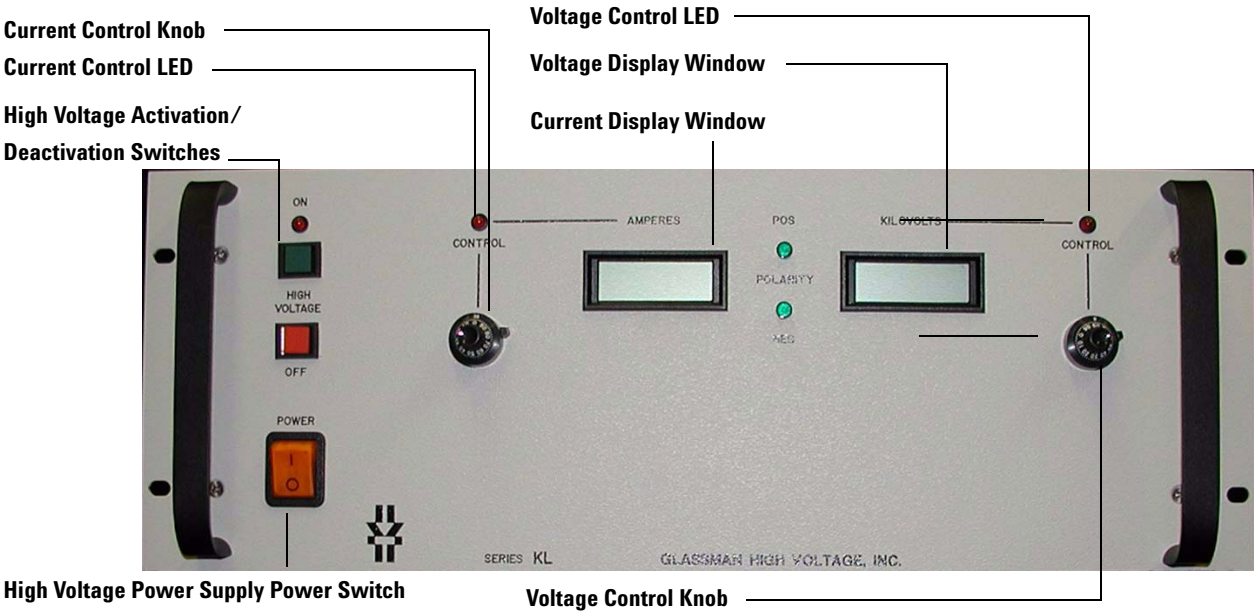


Figure 3 Glasman high voltage supply front panel

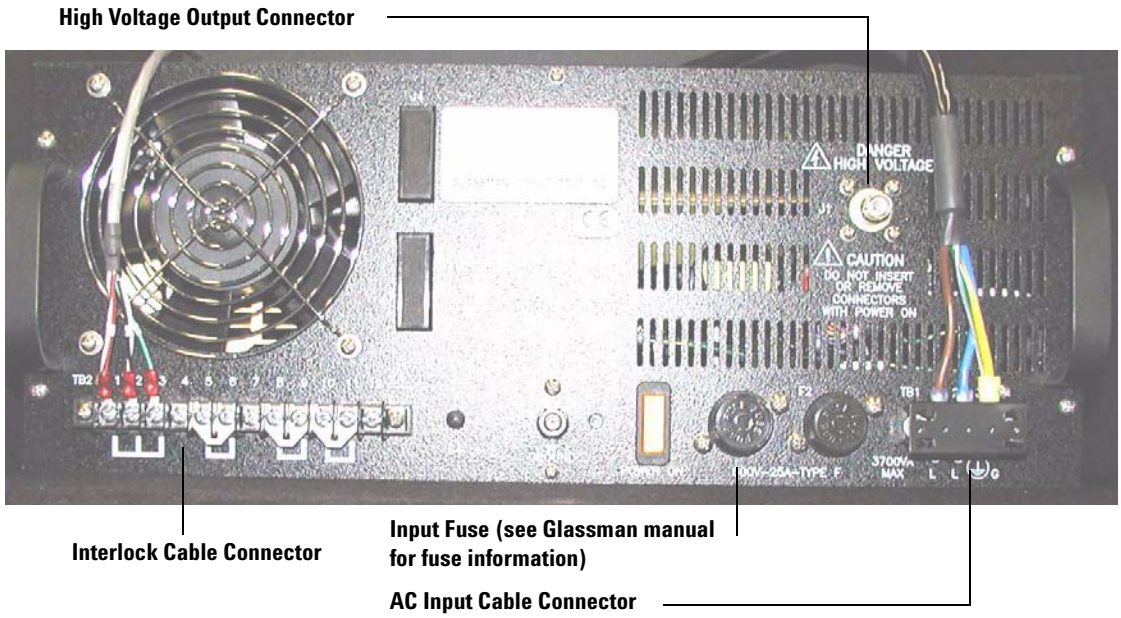
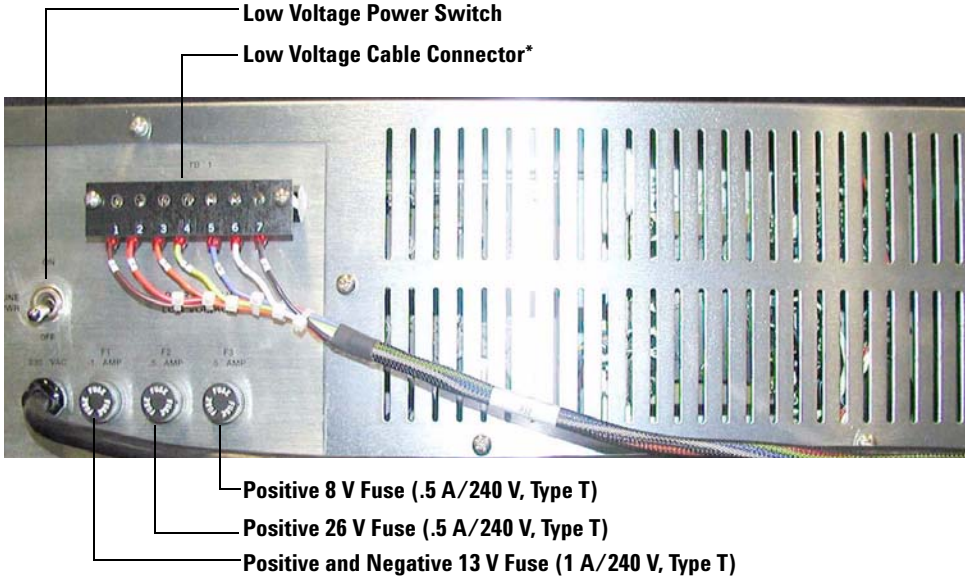


Figure 4 Glasman high voltage supply rear panel



*Cable connector
Pin 1 +13 V supply
Pin 2 13 V return (used for +13 V and –13 V)
Pin 3 –13 V supply
Pin 4 8 V return
Pin 5 +8 V supply
Pin 6 +26 V supply
Pin 7 26 V return

Figure 5 Low Voltage Supply

Powering Up the CMA Amplifier

Verification of connections

1. Verify connector **J16 RF out** (Figure 2 on page 9) is connected to a load cable that is attached to a load.
2. Verify that the high voltage cable from the Glassman power supply is connected to connector **J15 Hi volt in** (Figure 2 on page 9) .
3. Verify (Figure 2 on page 9) that the cord is connected to the blower input connector.
4. Verify that the RF in cable is attached to connector **J14 RF in** (Figure 2 on page 9).
5. Verify that the Hi Volt Rtn cable from the Glassman is attached to connector **J33 Hi Volt Rtn** (Figure 2 on page 9).
6. Verify that the Low Voltage Supply cable is attached to connector **J32 Low Volt** (Figure 2 on page 9).

Powering up the low voltage supply

1. Verify that the fan is plugged in and is blowing.
2. Turn on the low voltage supply (Figure 5 on page 11).
3. Verify that the **RF overload**, **Hi Volt Delay**, and one of the class LED's are lit (Figure 1 on page 8). (The class LED that is lit should have the knob pointed toward it.)
4. Set the class to class AB if it is not there already.
5. Wait for approximately 3 min. and the HI Volt Delay LED should go out (Figure 1 on page 8) .
6. Press the **Trip reset** button (Figure 1 on page 8) to clear the RF overload fault, and to turn off the RF overload alarm LED.
7. Verify the trip level at –7.5 Vdc using a DVM.

Powering up the high voltage power supply.

1. Turn on the power switch (Figure 3 on page 10).
2. Turn on the high voltage switch (Figure 3 on page 10).
3. Adjust the current control knob to the maximum setting (Figure 3 on page 10).

4 SLOWLY adjust the voltage knob up to 9.8 setting or 2.25 KVdc noting that the current reading raises slowly to approximately .033 to .060 A.

5 Turn the class switch on the CMA amplifier (Figure 1 on page 8) to class C and note that the current on the high voltage (Figure 3 on page 10) goes from the .033 to .060 A reading to approximately .020 to .025 A. Reset the class back to class AB.

Tuning the CMA 200-600 MHz amplifier

1 Connect a wattmeter to the output of the CMA amplifier (Figure 2 on page 9) through a short (1 meter or less), high quality RF cable.

2 Connect a 50-ohm load to the output of the wattmeter through a short RF cable.

3 Set the tuning knobs (Figure 1 on page 8) to the recommended rough tuning setting as indicated on the included test results sheet.

4 Power up the unit (Figure 2 on page 9).

5 Adjust input power to approximately 20 W, 10 ms pulse width at 10 ms delay (Figure 1 on page 8).

6 Adjust all **four tuning knobs** to optimize output power (Figure 1 on page 8). An effective strategy is to first independently adjust both input tune and input match settings to optimize power output and then interactively tune. For example, displace the output load setting away from optimum and readjust the output tune. If power is increased, repeat. If it is reduced, adjust the output load setting in the opposite direction and readjust the output tune.

7 Adjust input power to get approximately 50% of rated output power.

8 Readjust all **four tuning knobs** for maximum output power. At this and subsequent steps the output load adjustment will be the most useful.

9 If the power did not reach rated power in step 6, adjust input power to get approximately 95% of rated output power and retune.

10 The final tune settings of the amplifier are those at maximum power even though the amplifier could be tuned for better gain at lower power. This is in order to assure the best linearity available from the amplifier.

11 Record the console amplitude and scaler settings for the maximum rated power settings of the CMA Amplifier.

12 Disconnect the 50-ohm load and wattmeter setup from the CMA amplifier and connect the Trip Reference Connection switch (Figure 1 on page 8) through the supplied cable.

13 Reattach the 50-ohm load and wattmeter setup to the output of the Trip Reference Connection switch (Figure 1 on page 8).

14 Set the console amplitude to the recorded maximum rated power setting that was recorded earlier.

15 Retune CMA amplifier through the Trip Reference Connection switch (Figure 1 on page 8) to optimize output power. (Approximately 1 to 2 db less than maximum rated power output of the CMA amplifier).

Maintenance

These units do not have any user serviceable parts other than the external air filter on the RF deck and the externally accessible fuses on the low voltage and high voltage supplies.

The foam air filter on the RF deck must be kept free from visible accumulations of dust. The dust may be removed with a vacuum cleaner or with clean compressed air.

Troubleshooting

Flow charts on the following pages provide troubleshooting steps for your unit.

- The unit does not allow the high voltage to activate (Figure 6 on page 17).
- The unit is not amplifying; the unit has lost a lot of gain (Figure 7 on page 18).
- The unit RF overload LED lights immediately when RF is applied (Figure 8 on page 19).
- Front panel LEDs went out or will not light when unit is powered up (Figure 9 on page 20).
- The RF input is not present at the CMA amplifier (Figure 10 on page 21).
- Verify that the system load (Trip Reference Connection switch) is good or bad (Figure 11 on page 22).

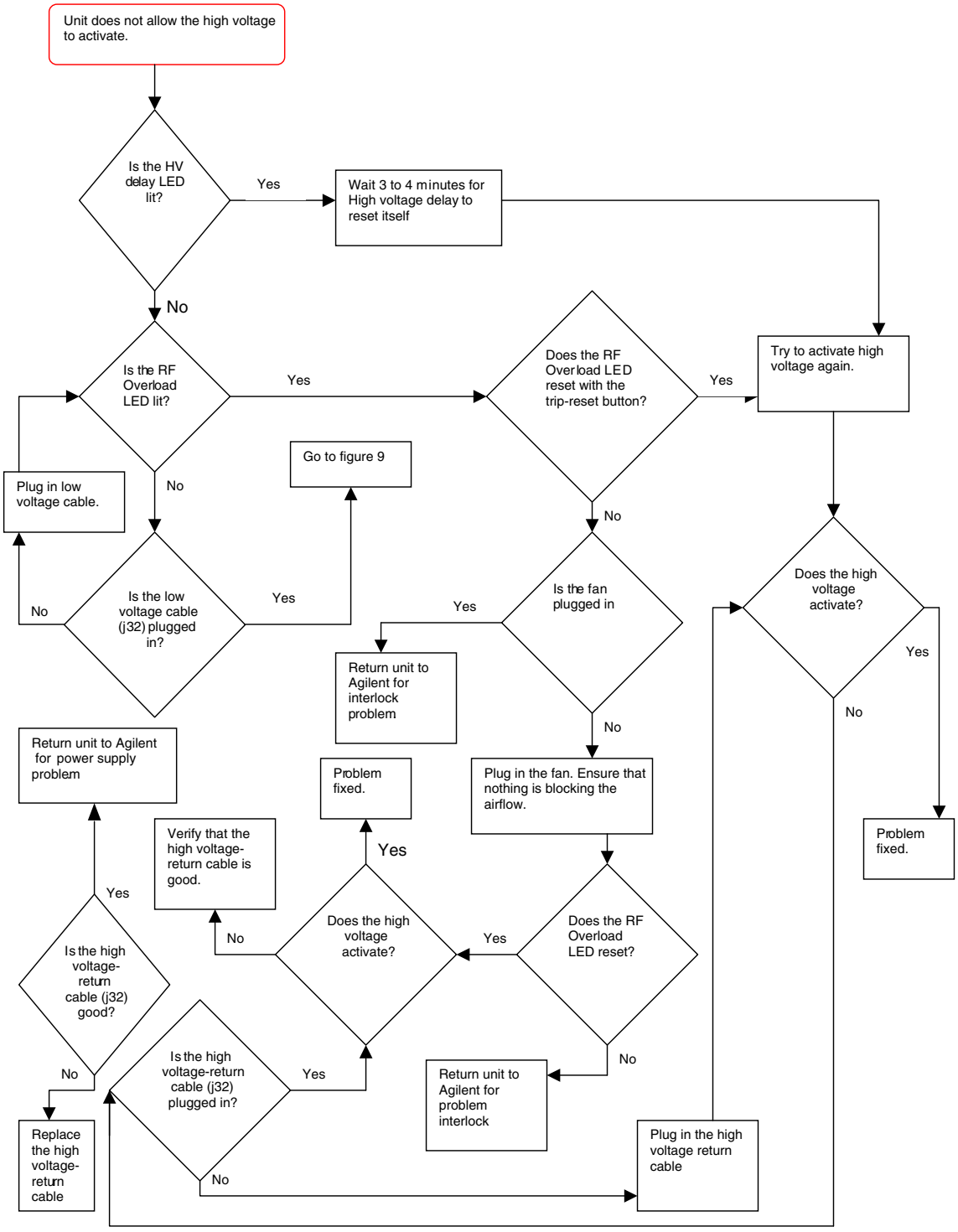


Figure 6 The unit does not allow the high voltage to activate.

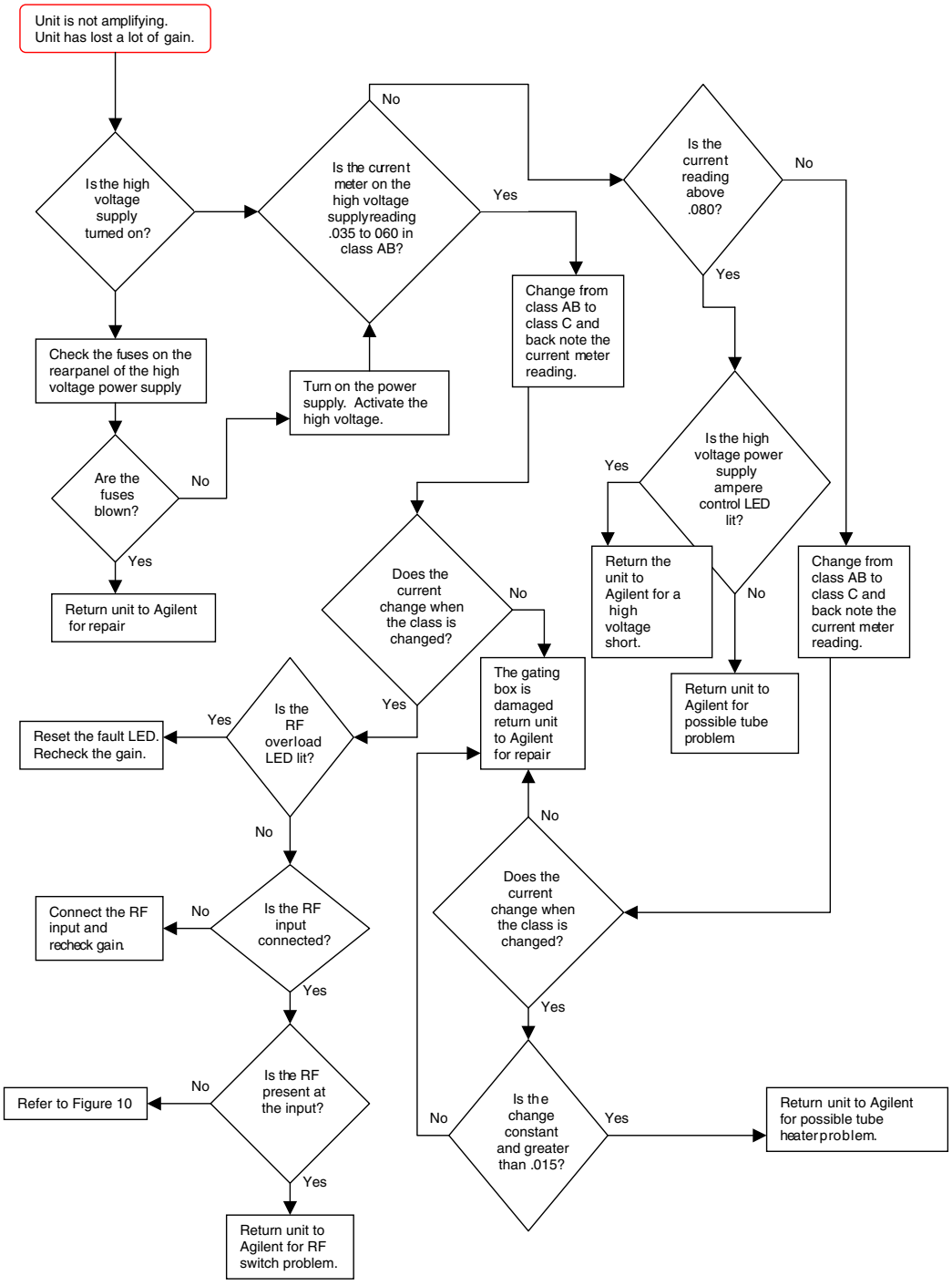


Figure 7 The unit is not amplifying: the unit has lost a lot of gain.

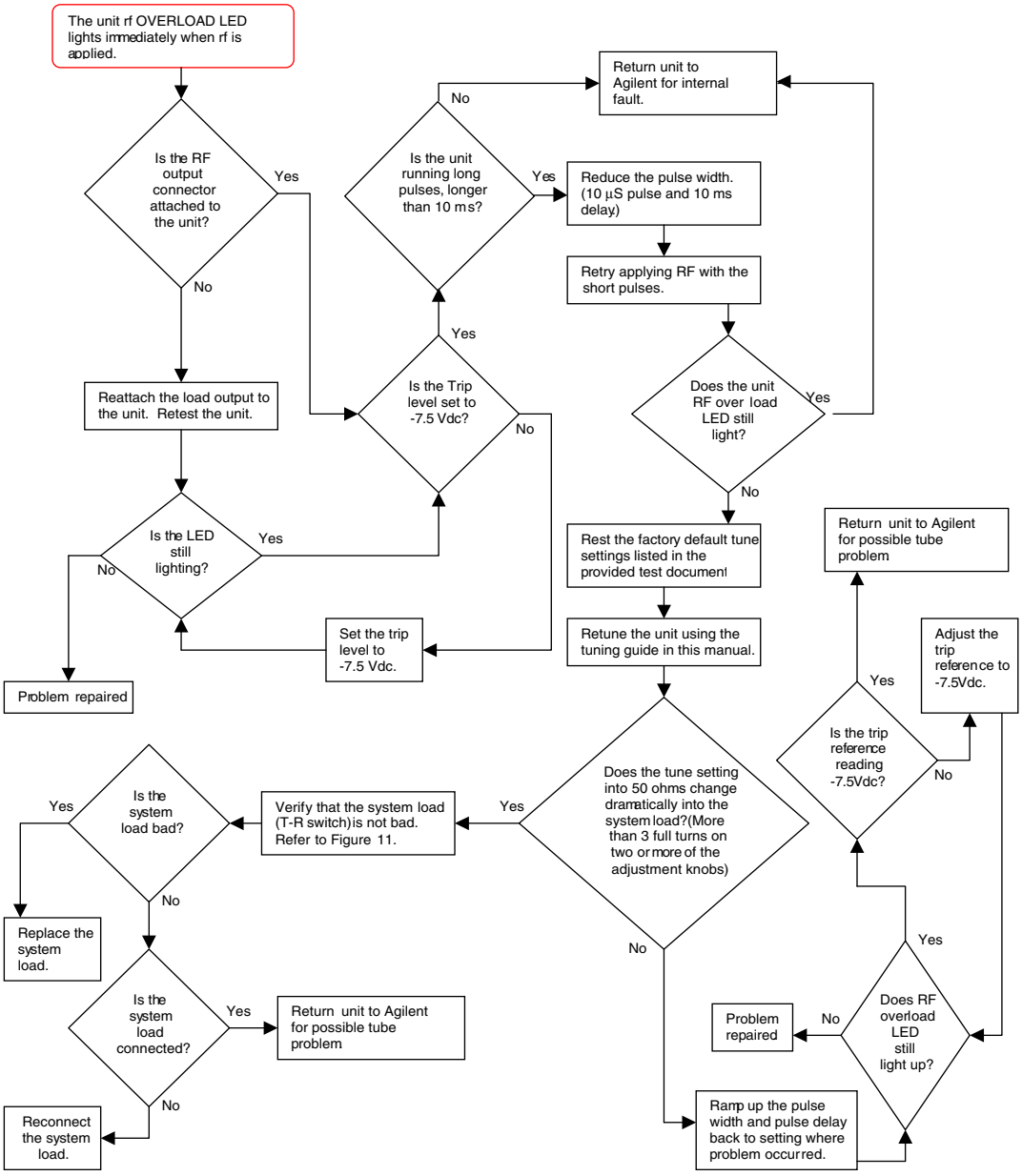


Figure 8 The unit RF overload LED lights immediately when RF is applied.

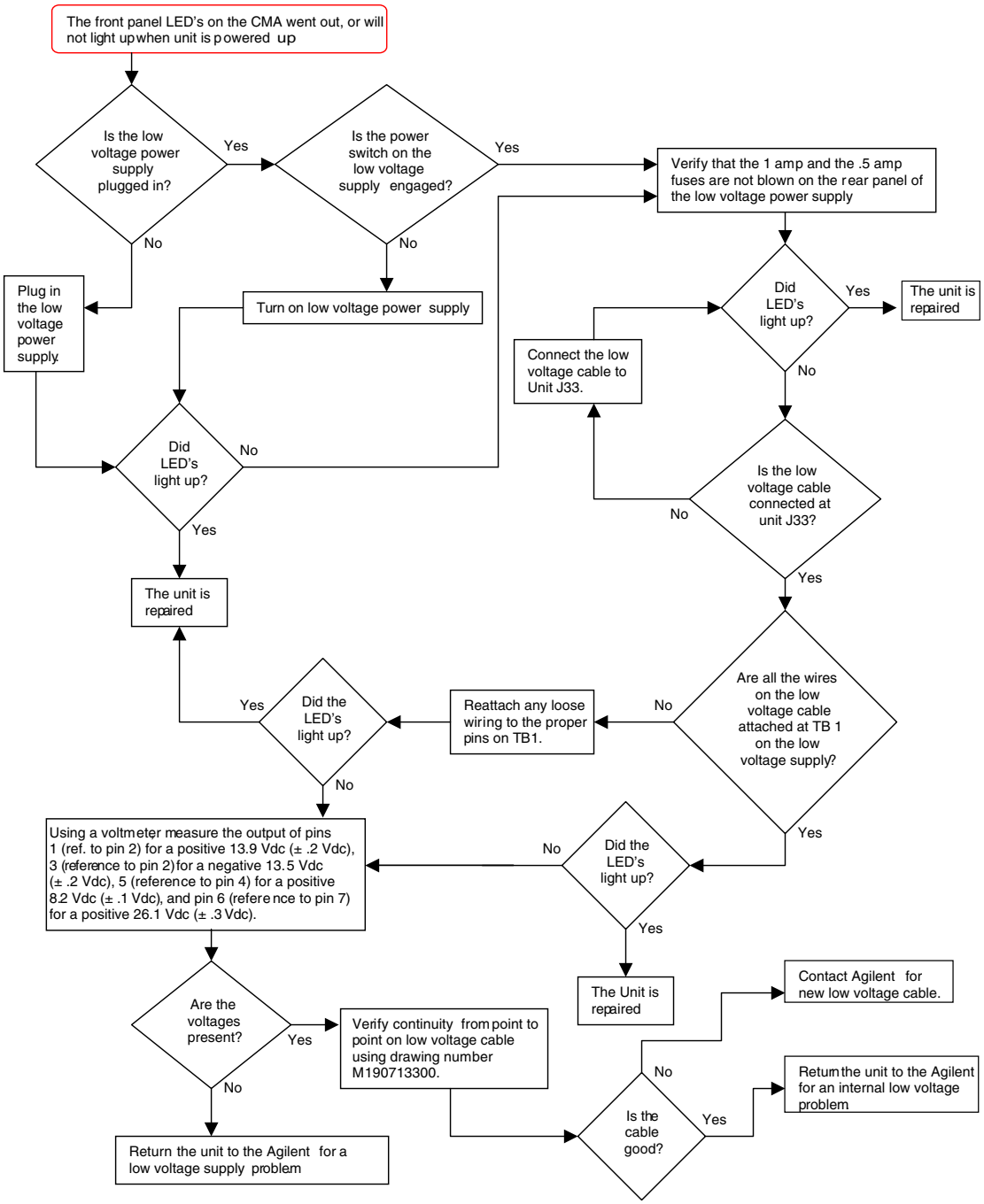


Figure 9 Front panel LEDs went out or will not light when unit is powered up.

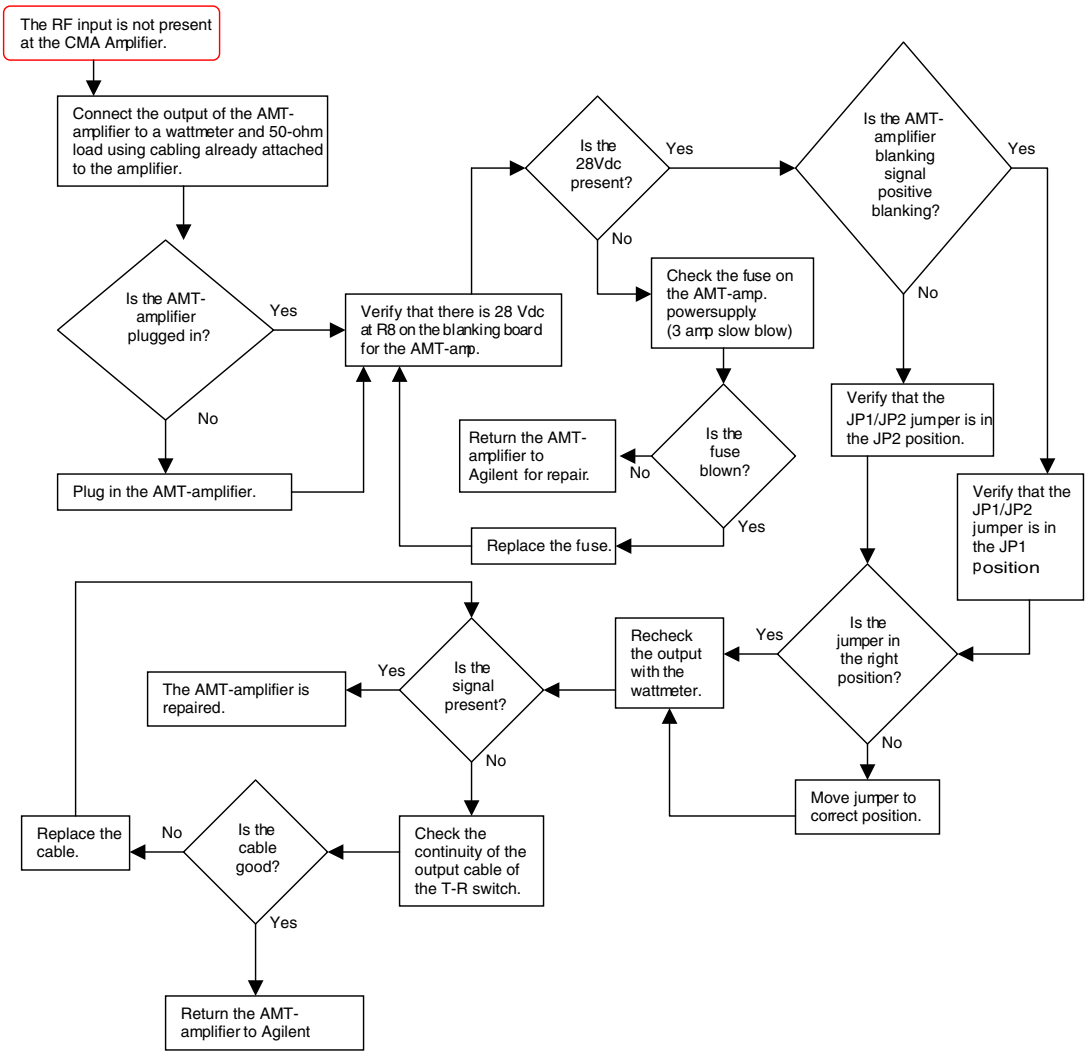


Figure 10 The RF input is not present at the CMA amplifier.

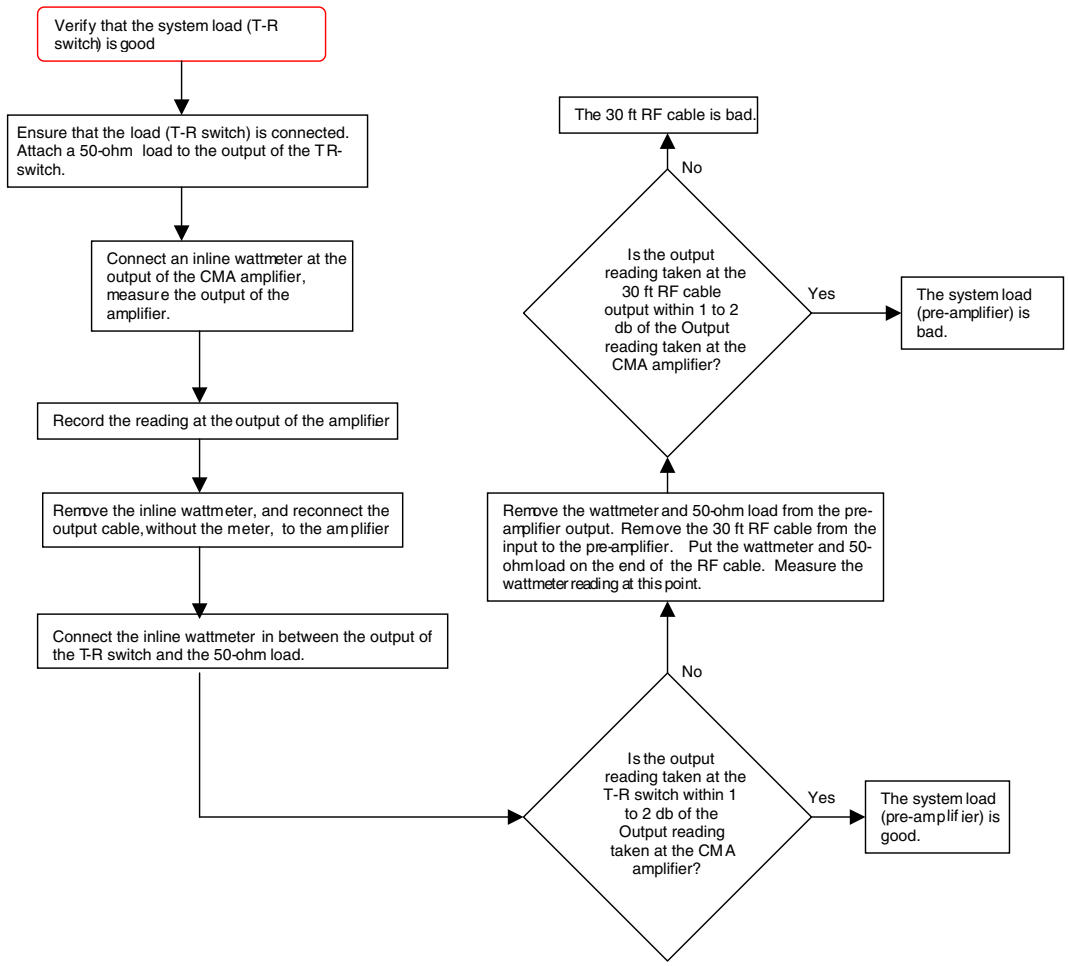


Figure 11 Verify that the system load (Trip Reference Connection switch) is good or bad.

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