2.4GHZ 10W SSPA for IC905 – VK4MJF

Introduction

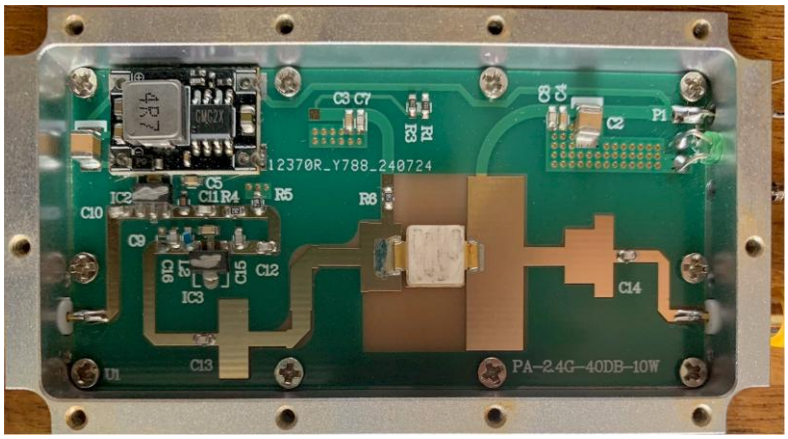
This project was conceived by John VK4MJF as an increase of power output for his IC905 for field days. Center piece was an eBay 2.4-2.5GHz 10W Output RF Power Amp 40dB 24-28V priced at A$100 from Shenzhen, China.

I got the job of letting the magic smoke out. I do not disappoint. Success in a flash.

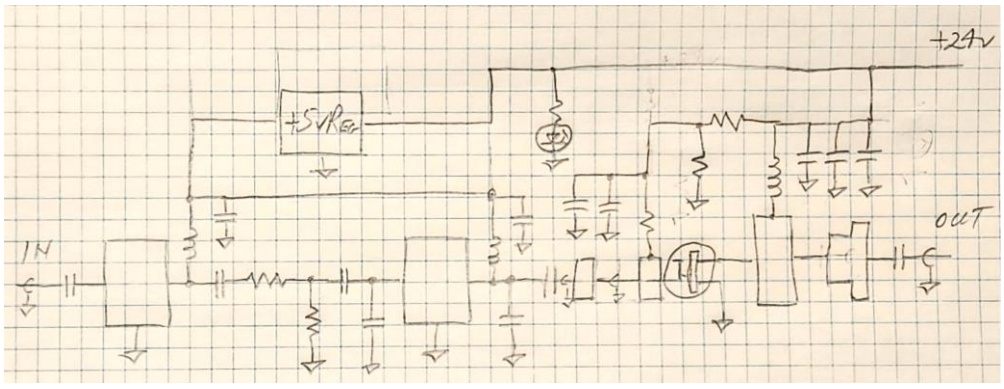
These notes describe the finished unit and some of the path getting to a seamless marriage to John's IC905.

Amplifier Module Modification for IC905 Drive

As purchased the WYZ-PA-2.4GHz-10W has 40 dB of gain. A 30dB 2W attenuator was included to reduce the IC905 drive to specification for the amplifier. Later tests showed the driver stages can overdrive the output FET. The FET bias was derived simply by a resistive divider from the 24V input supply. This risked failure of the amplifier by over-drive or excessive quiescent current / dissipation.



Original Module



Original Schematic

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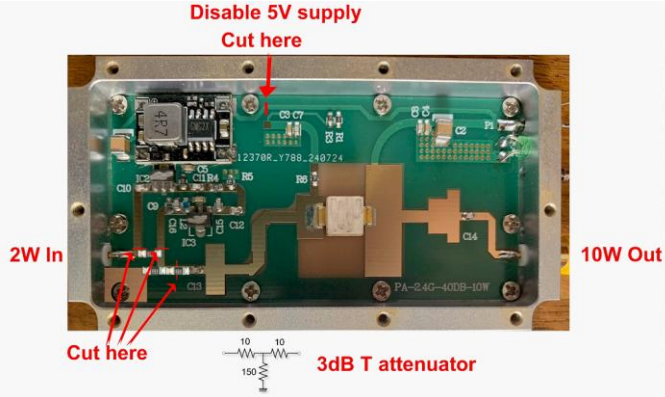
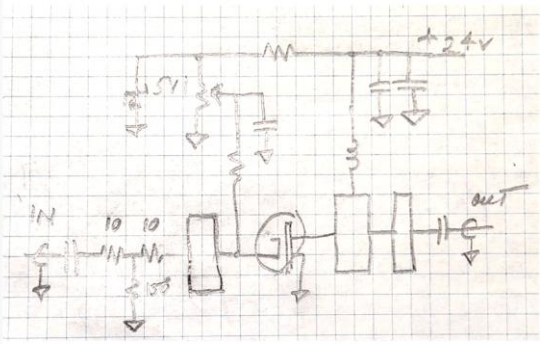
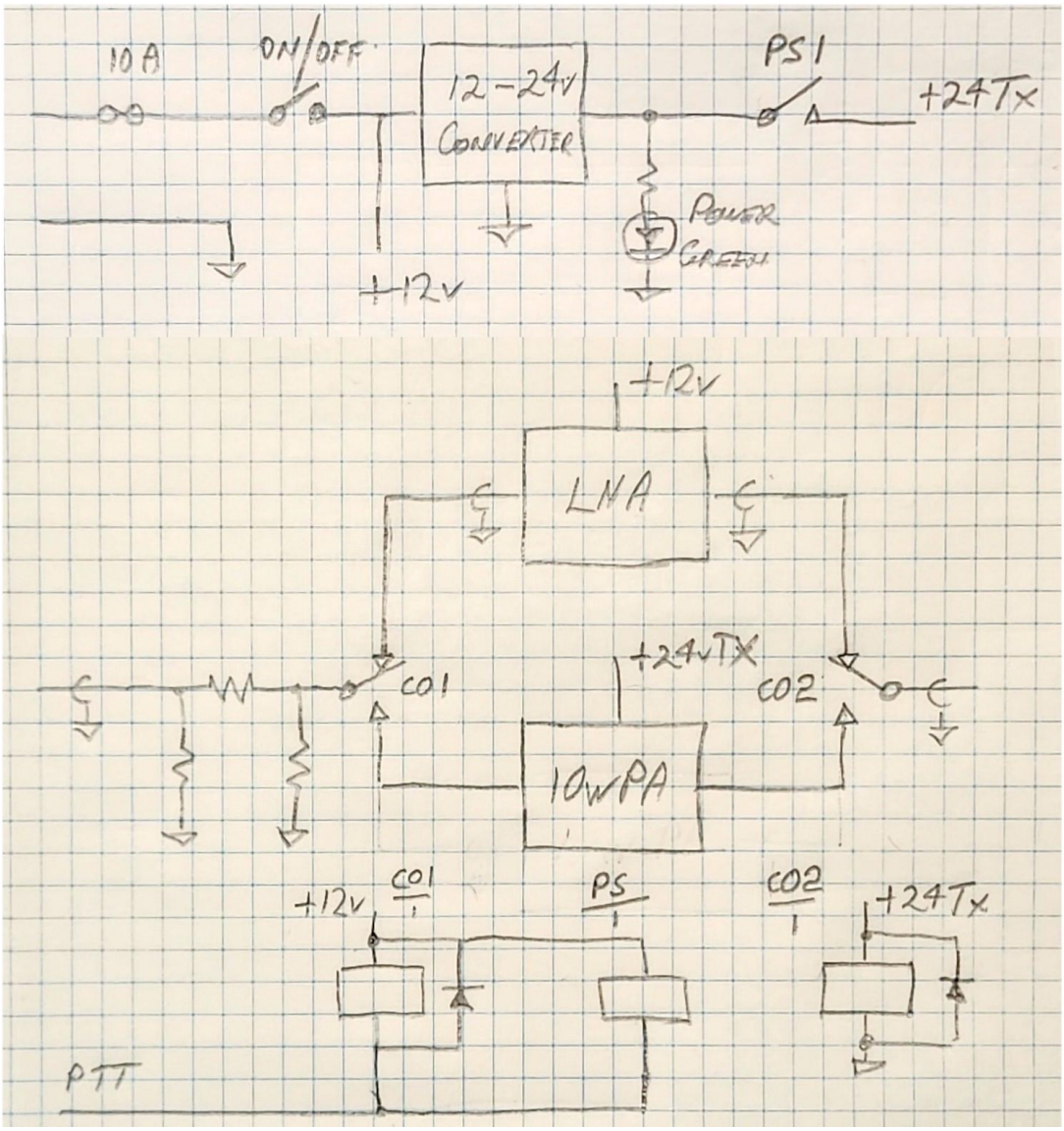
Modification of the amplifier for higher reliability is recommended.





Recommended modifications for 0.3W drive

System Design



System Block Diagram

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As the amplifier and the selected SMA microwave relay operates from +24V, the design was complicated. A 12 to 24V step-up converter was required. A module by W6PQL was available.

It is necessary to provide a DC supply relay to control the +24V on transmit.

For field day use, a LNA was added to the system.

LNA

A LNA using the excellent Qorvo TQP3M9037 gain block (eBay) as an assembled LNA module was added to the design.

A 6dB pad was built on the input relay module to reduce the drive from the IC905 and minimize the risk of rear-ending the LNA.

The LNA noise figure with relay and coax losses measured at 0.4dBF, 14dB overall gain.

A PGA-103 stage was added as a second stage to the LNA as there was concern that the TPQ3M9037 gain less the attenuator and relay losses may not be sufficient to mask the noise figure of the IC905 receiver. Field testing indicated that the combined gain of 30dB is too high. A 10dB attenuator between the LNA stages may provide the right balance.

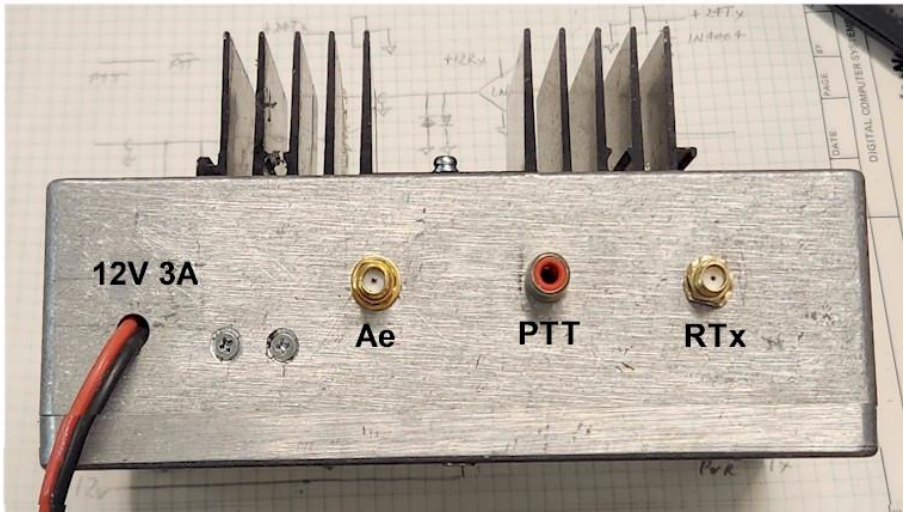
Construction

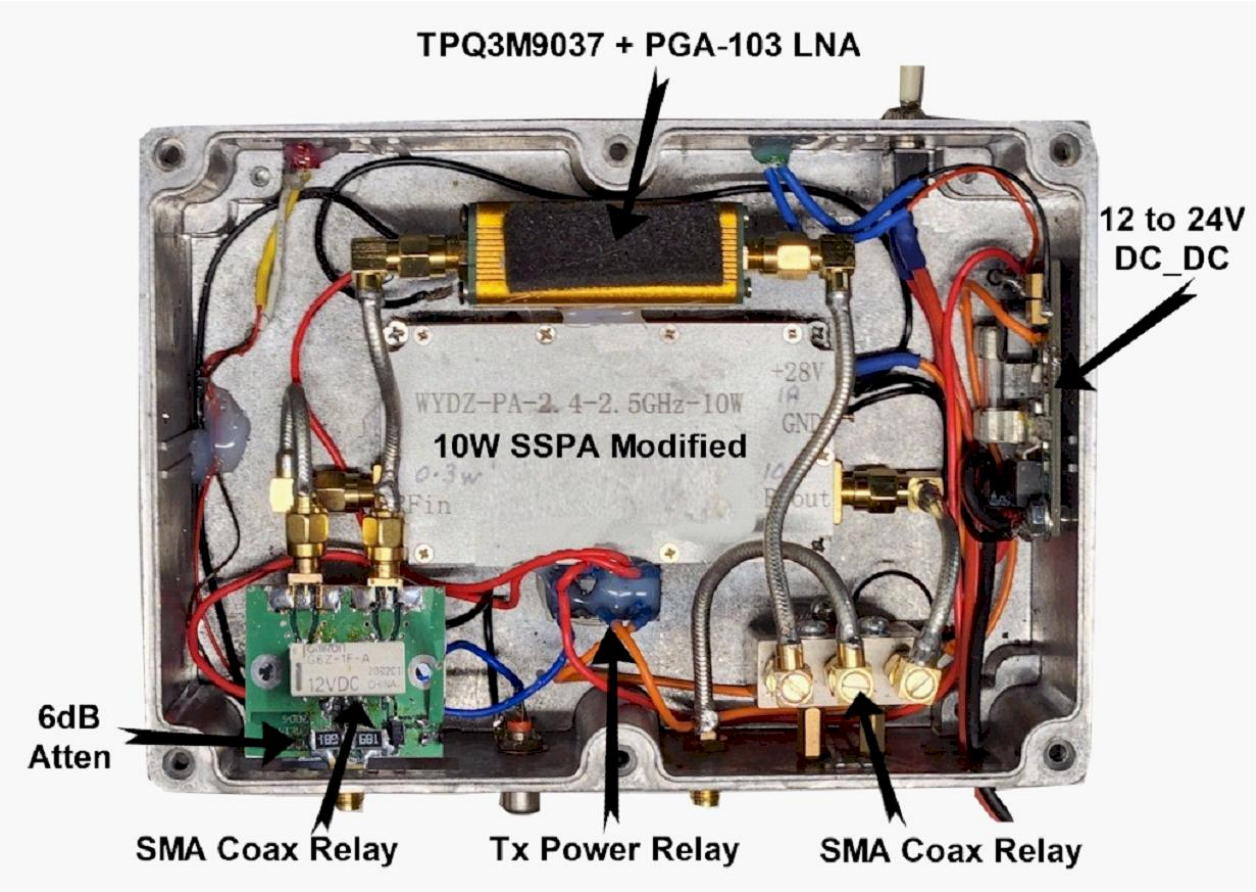
The amplifier with the LNA, changeover and power relays, and 12 to 24V DC step-up converter was built in a diecast box.

Power switch and LEDs for power and press-to-talk (PTT) were mounted on one face.

SMA coax connectors for transceiver and antenna, and an RCA connector for PTT were mounted in the opposite face.

The amplifier was mounted in the bottom of the box and an extruded heatsink mounted on the outside of that surface.





Receive consumption is less than 300mA. Current drain at 10W output was around 3 A at 12V.

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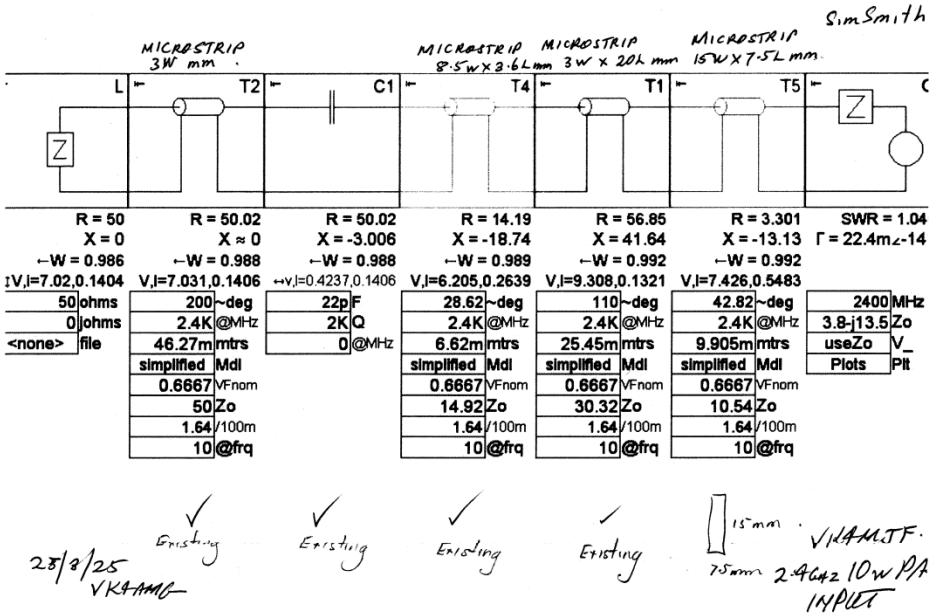
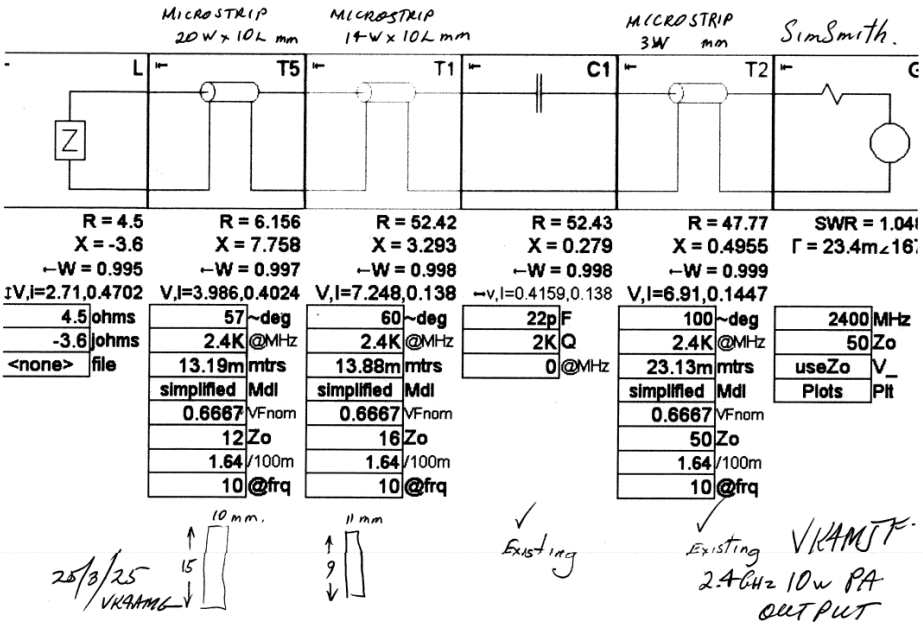
10W FET Replacement

As the FET in the first amplifier module died during initial testing and as the part numbers had been erased on the components in the amplifier, a replacement was sought. Finding a replacement was not easy.

A new FET P1F240101S, purchased from eBay, was selected based on 24V supply, gain, and power output. While FET was similar to the original, some changes were required to the microstrip matching to achieve 10W drive and low input SWR. The Sim Smith design tool reports for the input and output network are presented below.



Input Matching for P1F240101S Replacement FET



Output Matching for P1F240101S Replacement FET

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Matching modifications for P1F240101S FET

The original MMIC stages were bypassed. Brass shim was soldered to the existing PCB tracks to achieve the microstrip matching modifications.

With the new FET, bias stability was improved using a 5V Zener and a 10k potentiometer for quiescent current setting of 250mA.

After modification 0.3W drive was required for 10W output.

Conclusion

The complete unit justified the original power amplifier module selection even if smoke letting occurred in the learning.

With the recommended modifications, the amplifier module should provide a painless project.

The small physical size and 12V DC operation makes the amp great for field days. “It worked a treat on its first M A D (microwave activity day) outing”, John VK4MJF