IC 910H External ALC Control

While experimenting with combining ALC from 2m and 70cm SSPA for control of an IC910H, the dreaded 'spike on PTT' was identified and quickly killed two FETs in the NEC UHF amplifier module.

Figure 1 shows a full power spike of short duration occurring when the transmitter was terminated in a dummy load. The waveform is captured using a directional coupler and RF power detector. Yellow trace is PTT and blue, RF output (FM mode).

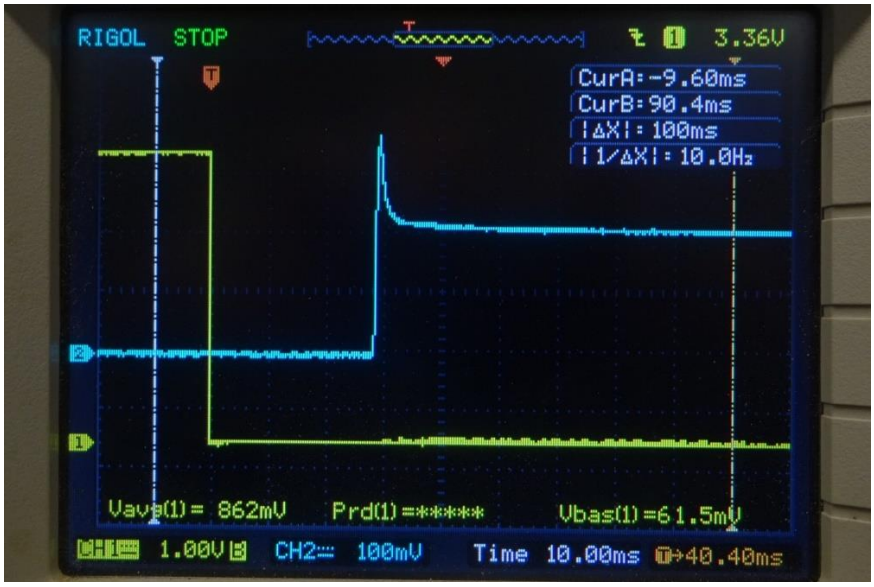

Figure 1- Spike on PTT - dummy load

The spike (Figure 2) changed to 20ms duration full power when the transmitter was driving the 70cm SSPA with its sequencing and protection. RF power control has been set to a lower level than that in Figure 1. What part of this spike appeared at the input to the amplifier module was not investigated. Any part is potentially a FET killer.

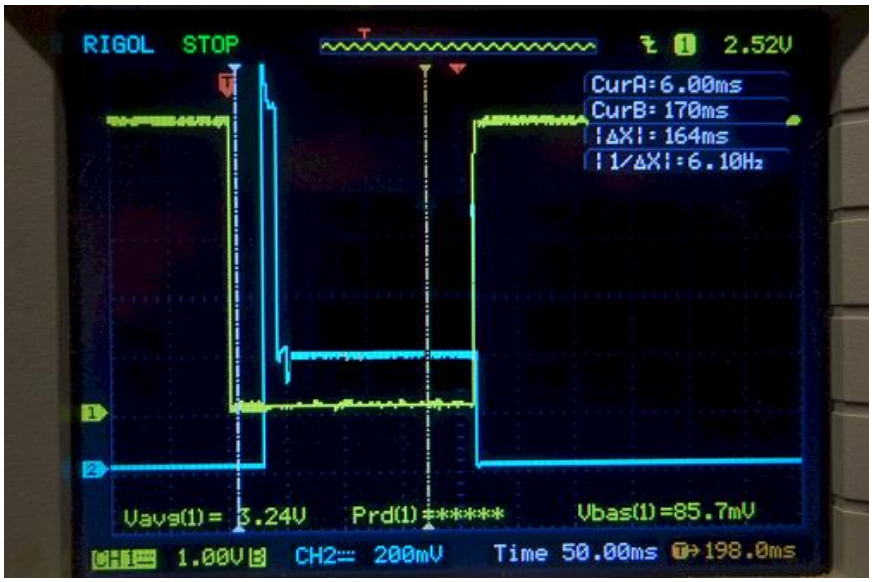

Figure 2- Spike on PTT - 70cm SSPA with sequencing

As the behaviour of the ALC on the IC910H was found to be different from the other ICOM radios where external ALC had been applied, the operation of the IC910H external ALC was investigated.

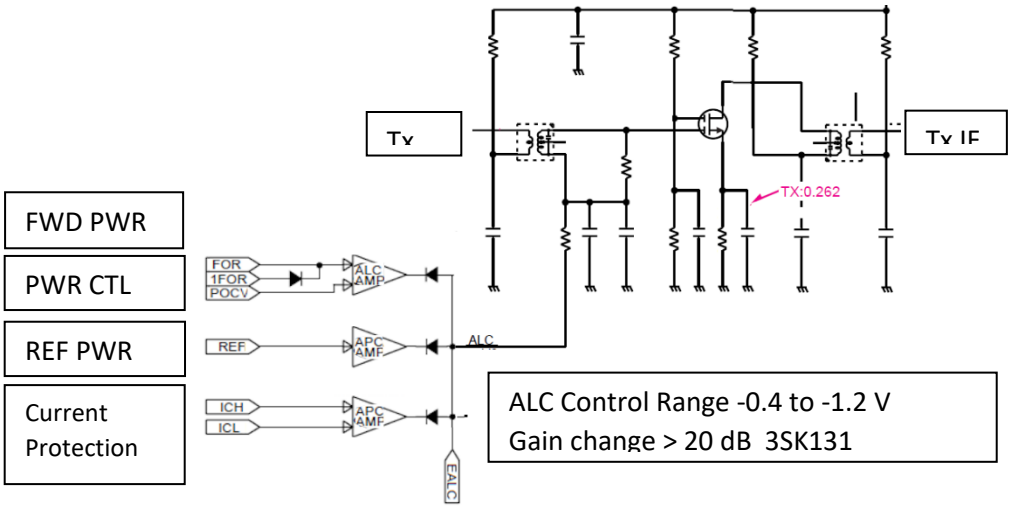

Figure 3- Simplified IC910H ALC schematic

The gain of the transmit IF amplifier is controlled to set the output power level, provide SWR protection, and provide PA current protection. As the IC910H has three power amplifiers (2m, 70cm, and 23cm) the monitoring signals (forward power, reflected power, and PA current) are combined before being fed to the amplifiers producing the negative ALC voltage. The outputs from the three ALC amplifiers are diode combined. The external ALC is applied directly to the combined point, gate one of the Tx IF amplifier. Examination of the 3SK131 data sheet shows a gain change of over 20dB may be achieved with a change from -0.4 to -1.2 volts. Application of an ALC voltage outside this range may prevent normal operation of the Tx IF amplifier (No transmitter output may be the result).

The spike in output power appears to be due to the indeterminant state of the control signals and the resulting ALC voltage at the instant of PTT. The time constant associated the R & C of the bypass circuits on the gate of the Tx IF amplifier causes a delay on gain reduction of this stage.

Any components on the external ALC line (pin 8 of ACC connector) will also affect the application of the output power setting ALC. Any external ALC signals should be applied via a diode and any impedance applied to the external ALC pin should be high impedance. A value of 220K was used to set the time constant of the ALC to around 50 ms.

Figure 4 is the schematic of my external ALC preconditioning and combiner for the ALC from the ALC of a SSPA for each band. The preconditioning aims to control the Tx IF amplifier from the instant of PTT rather than leave the gains and hence power output indeterminant until the internal ALC protection and power control is established.

A 555 timer is used as a voltage converter. An ALC voltage of -0.7 V was established as a compromise of holding the output power down and yet allowing an acceptable recovery time for the internal and external ALC signals (Approximately 100ms at about half power setting). Figure 5 shows the power output plotted against the PTT. Figure 6 and Figure 7 show the ALC voltage and output power for FM and SSB (constant whistle / Ahhh!) mode respectively.

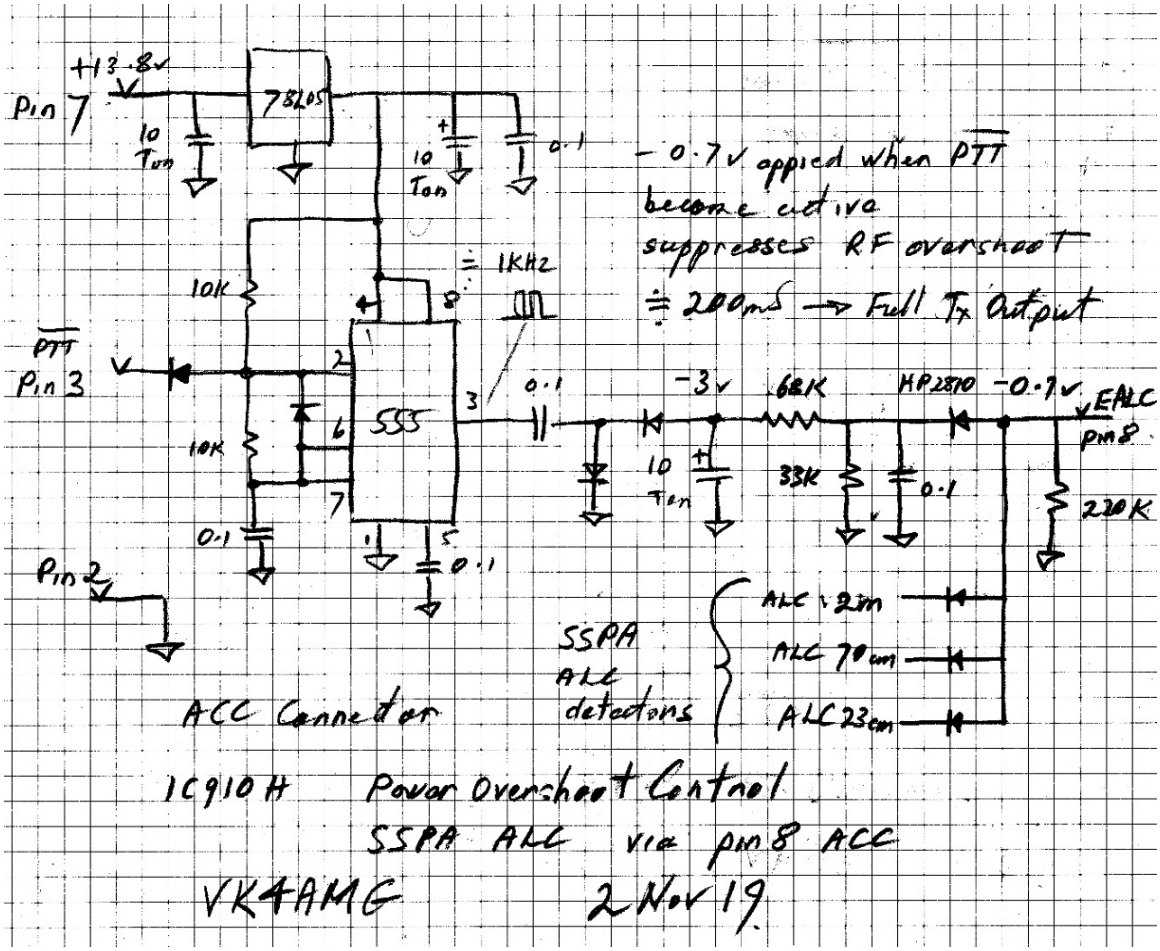

Figure 4- ALC preconditioning and external ALC combining

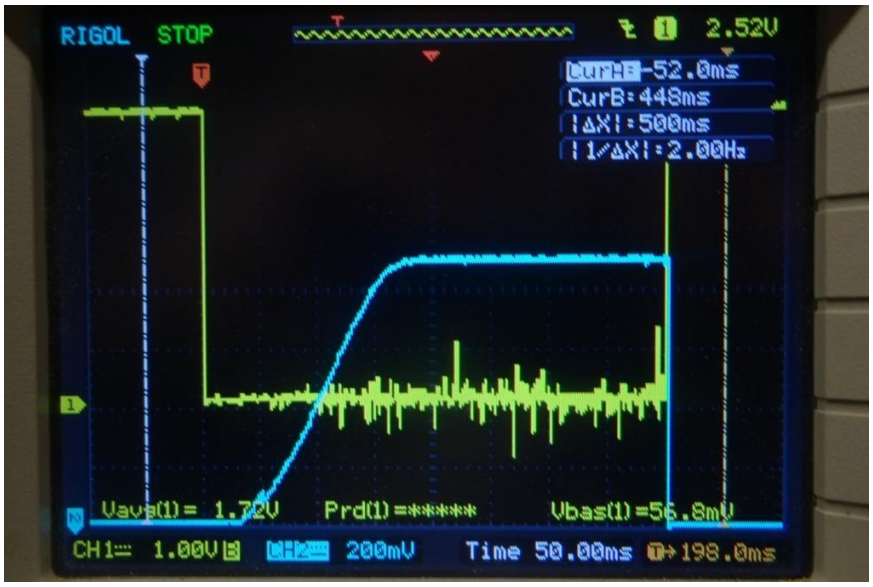

Figure 5- Recovery time from ALC preconditioning

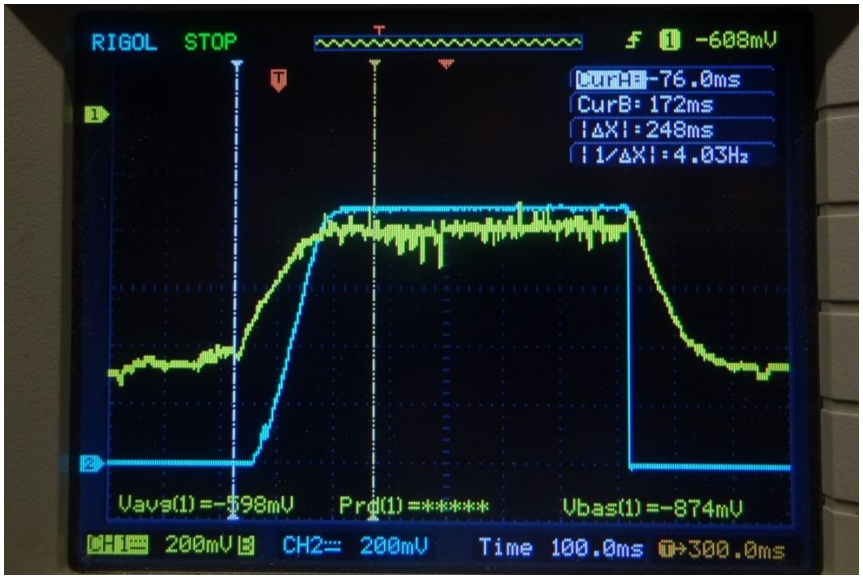

Figure 6- Combined ALC voltage and output power (FM mode)

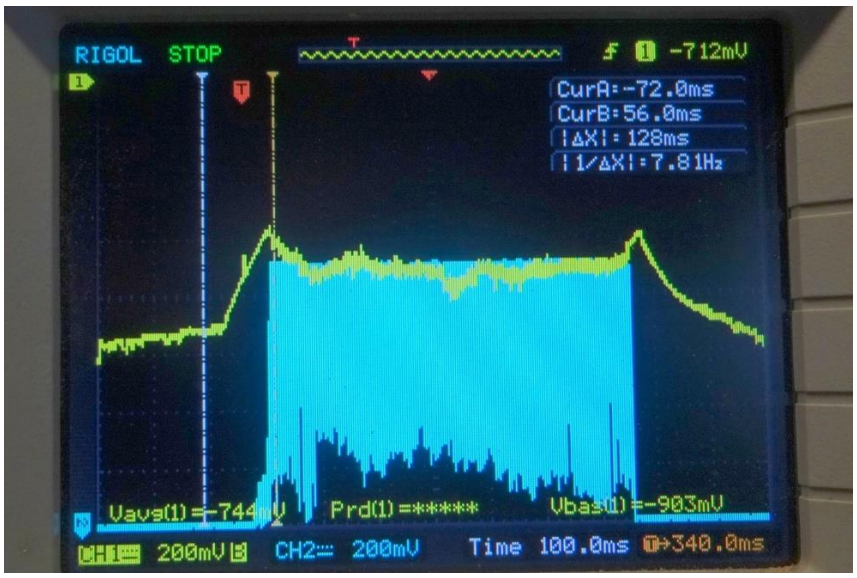

Figure 7- Combined ALC and output power (USB mode)

A small vero board prototype of the ALC preconditioner and combiner was installed in a Icom Milti-Send (VK4GHZ) case. The combination provides PTT and ALC connections from 2m, 70cm, and 23cm SSPA to the IC910H.

Figure 8 - ALC preconditioner and combiner installed in Icom MultiSend