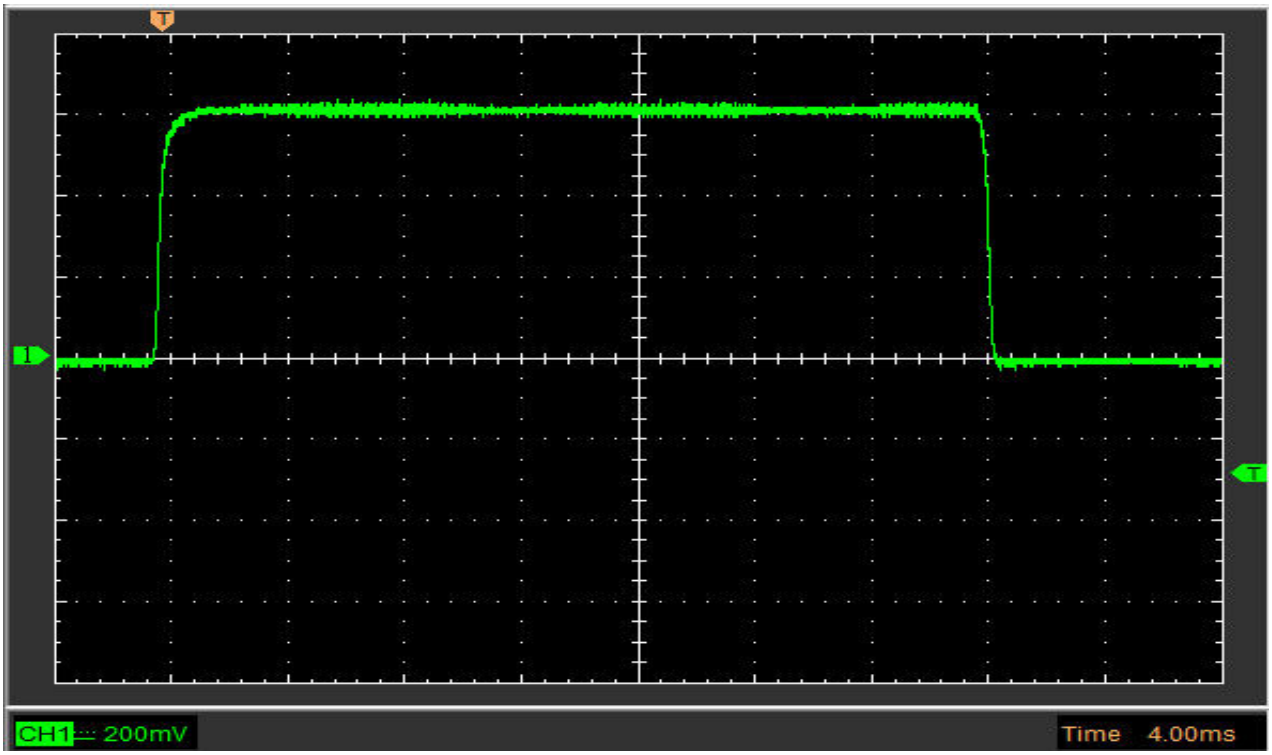
Investigation of poor VHF DMR performance of the MD-9600

There have been several reports on the Facebook group observing very high BERs on VHF DMR transmissions from the MD-9600. One recent post linked this to using the low power or medium power settings, saying the problem did not occur on high power. No similar reports have been made for UHF transmissions.

As power level should not affect the quality of the transmission I decided to have a look at the RF amplitude envelope during DMR transmissions as it sounded like this might be where the problem lay.

Test equipment used was a HP wideband diode detector connected to the output of the radio through a 30dB coupler and a variable attenuator. The through port of the coupler was connected to a dummy load. The output of the detector was connected to an oscilloscope. The variable attenuator was used to give the same amplitude output for the different power levels for comparison purposes.

As a reference the first test was made using a UHF Motorola DM4600 mobile radio. Unfortunately I do not have another VHF DMR radio to use as a reference but the diode detector and coupler are known to be flat with frequency so the measurements for VHF can be assumed to be correct.

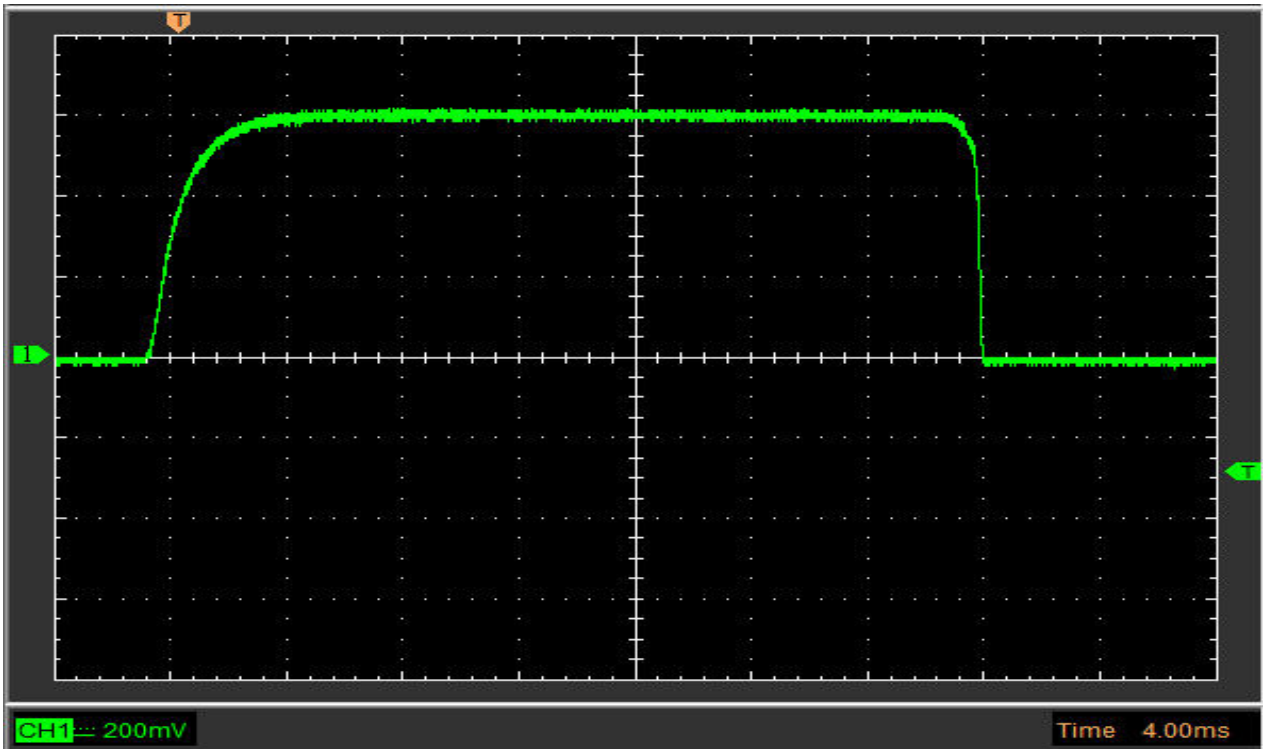


Motorola DM4600 UHF High Power

The DMR burst is allocated 30ms, of which the first and last 1.25mS are allowed for RF ramp up and ramp down. This leaves 27.5mS for the actual data burst.

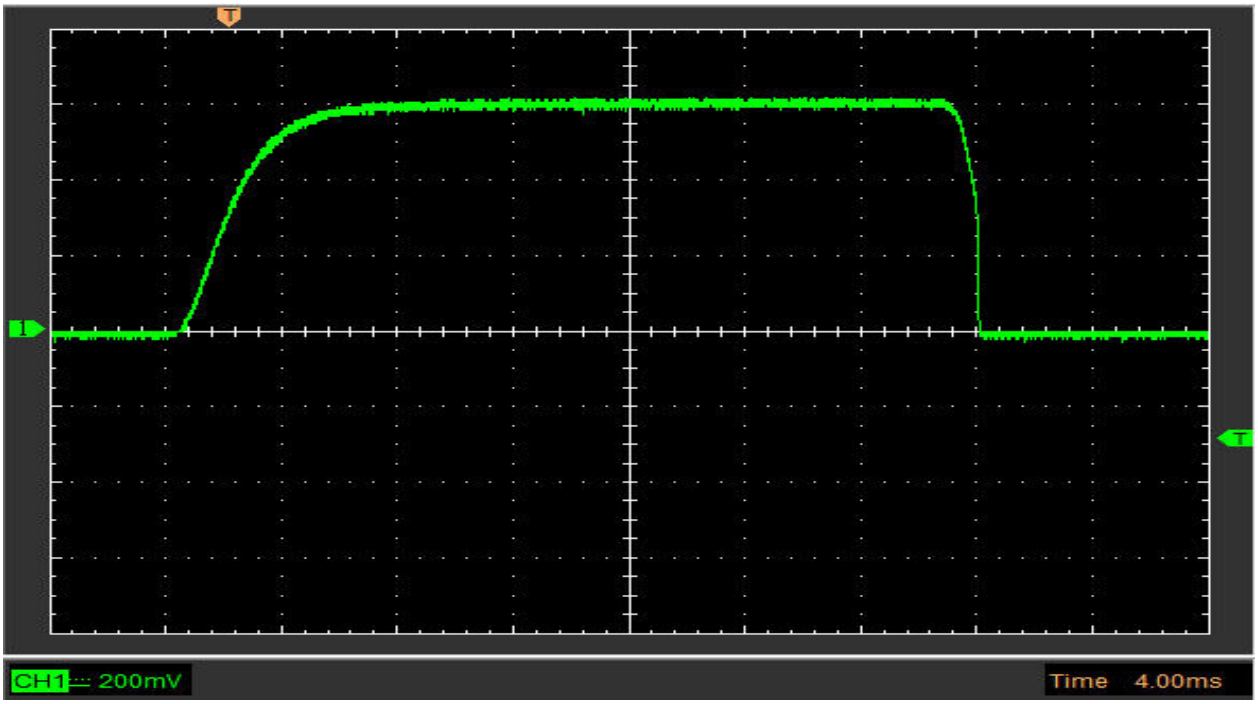
As can be seen from the reference plot above the DM4600 fits in well with these timings. The horizontal timebase is 4mS per division so it can be seen that total burst length is about 28.5mS with the central 27.5mS being very flat.
Repeating the test at low power with the DM4600 showed an identical envelope as would be expected.

Having made this reference measurement I then repeated the test with the MD-9600 on UHF High Power.



MD-9600 UHF High Power

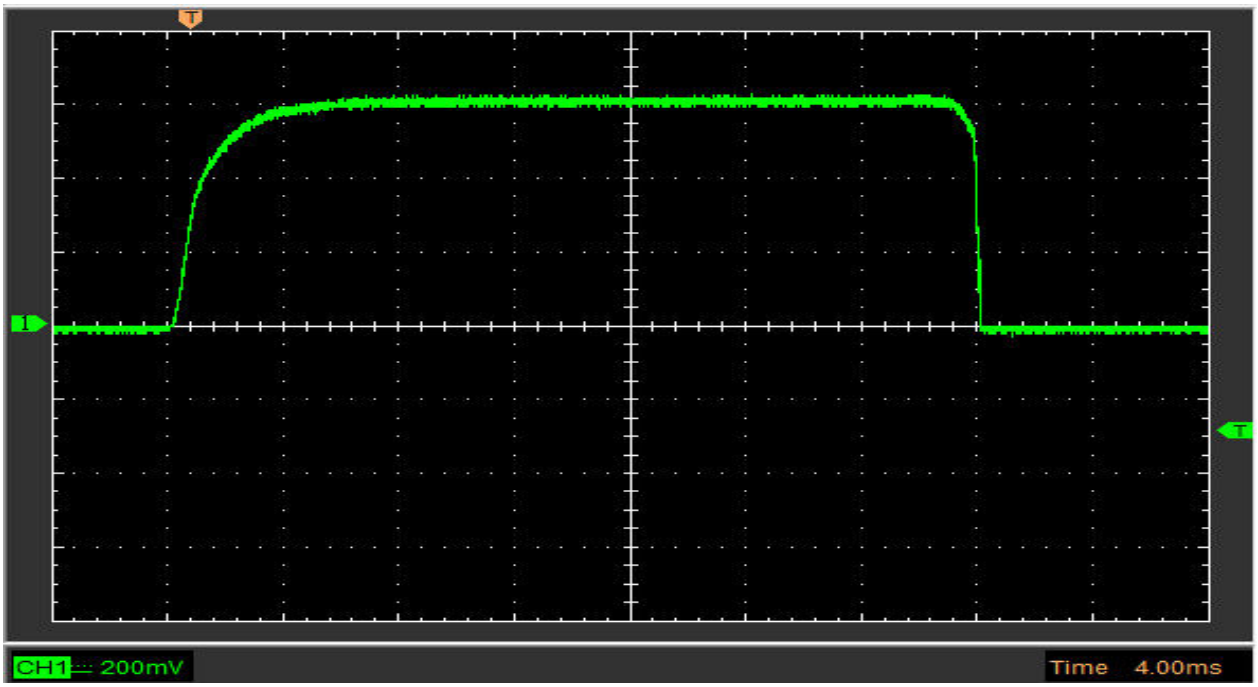
As can be seen the rise-time of the RF output is significant longer than the Motorola radio. Only about 24mS of the burst are at full power. During the first 3.5mS of the data period the RF amplitude is still increasing. This is not ideal but in most cases would probably not cause a problem with reception. The same test was then done at low power.



MD-9600 UHF Low Power

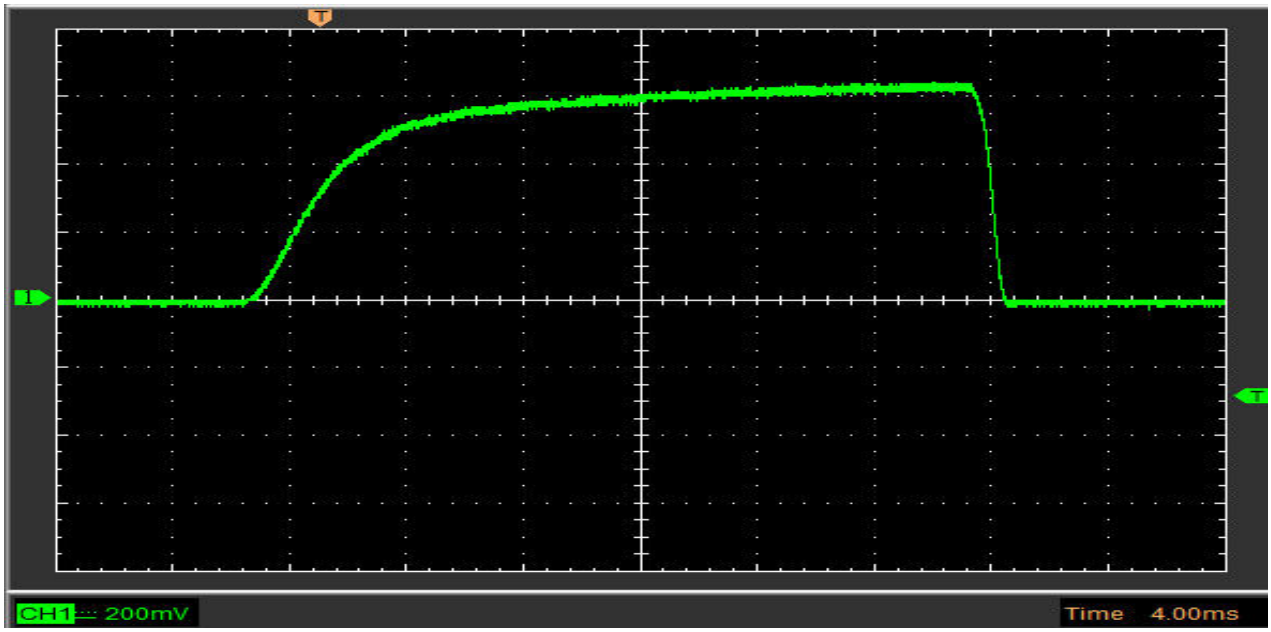
As can be seen at low power the rise-time is longer still. Only about 20mS of the burst are at full

power. During the remaining 7.5ms the RF power is ramping up from zero. I would expect this to be causing data errors in transmissions although it has not been reported. This may be due to people assuming the low power setting is the primary cause.
I then repeated the test at VHF high power.



MD-9600 VHF High Power.

The rise-time for VHF High power is similar to that for UHF but the starting time for the RF burst appears to be about 1mS later. The total time for the whole burst is less than 28mS. This, coupled with the slow rise-time means that the first few ms of the burst are at very low or maybe even zero power levels. This would certainly be noticeable as a poor BER on the transmission.
I then repeated the test at VHF Low power which is where people have reported significant BER increases.



MD-9600 VHF Low Power

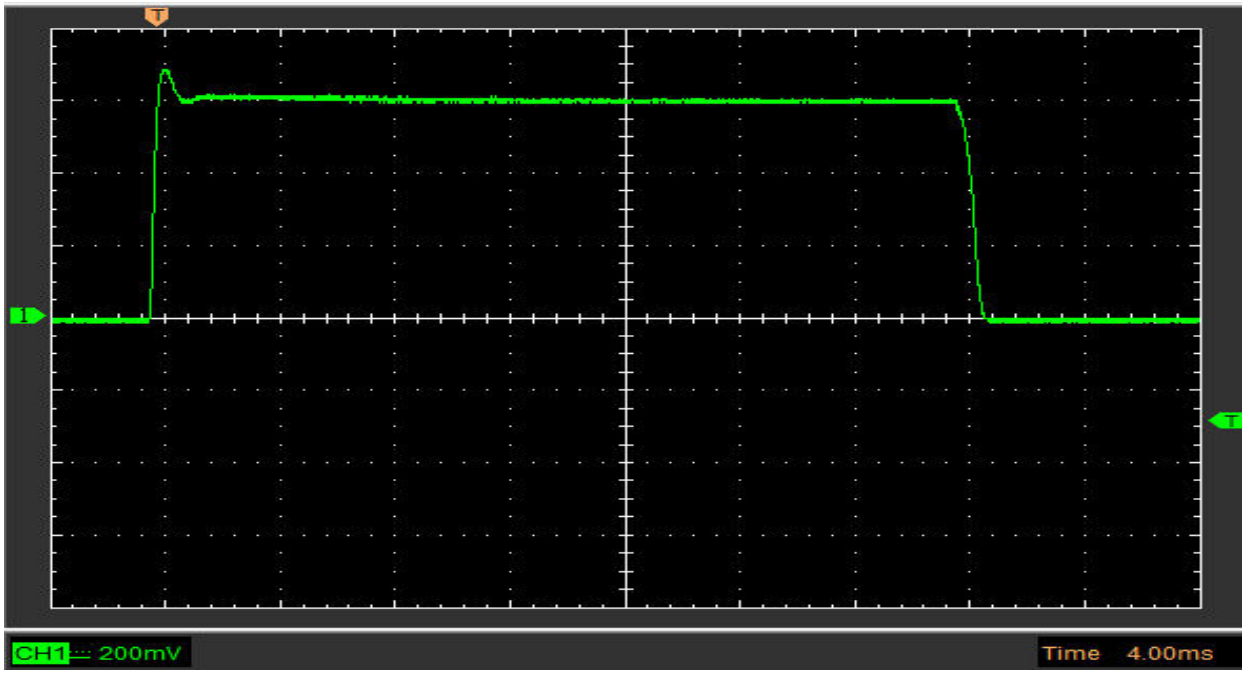
This plot was so poor that I was sure I had made an error somewhere so I repeated the previous tests

to make sure nothing had changed. It had not. The envelope of the MD-9600 on VHF Low power was really this bad.
The most significant point is that the length of the whole burst from zero power to zero power was only about 25mS. (just over six horizontal divisions instead of the previous 7 divisions). That means that at least 2.5mS of the data burst were not being transmitted at all. Also the rise-time is extremely slow resulting in the whole burst having a rising slope to it.

This RF envelope would defiantly result in a significantly high receive BER as is being reported by users.

Repeating the same test at the Mid-low and Mid-hi power settings showed the same shortened burst. This confirms peoples reports that only high power VHF works properly.

And finally, just to further verify the measurements I repeated the test with a UHF MD-380.



MD-380 UHF High Power

This shows really fast rise and fall times, in fact the rise time is a bit too fast giving a little overshoot. However this wouldn't cause any noticeable problems. So TYT can produce a good radio.

In conclusion it looks like there is a significant fault with the MD-9600 PA power control circuitry. Even on UHF the performance is not good but on VHF at anything other than full power there are serious problems.

As always these are the measurements on one particular radio, others may be different. However several users have reported similar poor performance on VHF so I suspect it may be a generic design problem.

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