

Collins KWM-2: An Adapter to limit Output Power

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Did you ever feel the need to increase the output power of your KWM-2 transceiver? Sure you did, every time you got a report with less than 5 and 9. But did you ever see the need to reduce the output power? No? But there may be a good reason. In Australia the "Foundation" amateur radio license limits the transmitter output power to 10 watts. And if you are a Collins enthusiast and want to put a KWM-2 up into the air, there is a problem to be solved.

In spring 2014 the question came up on the CCA mail reflector, and one of the first ideas was to reduce the PA screen supply, probably fostered by the observation that in "Tune" mode with reduced Ug2 the KWM-2 delivers about 14 watts into the load. Immediately several possible solutions were entered into the discussion:

- Simply turn down the Microphone Gain and watch a PEP output meter not to go beyond 10 watts. That may work, but only with highly disciplined operators. Furthermore, this solution would probably not be acceptable for a licensing authority.
- Put a 10 dB 90 watt resistive divider between output and antenna tuner. Definitively works, and nice when you want some additional heating in the shack.
- Reduce the screen grid supply for the 6146s. Easy to apply: open the jumper between J5 and J6 (PA disable) and replace it with an 18 KOhm 2 W resistor. That way the screen supply is permanently reduced. But now the tubes are no longer working in class AB1, grid bias is too high and the PA is more or less in class C now. Not good for SSB. Of course, the grid bias can be lowered to produce the idling current needed for a low distortion PA. Unfortunately it turned out that the standard bias adjustment range in a 516F-2 is not large enough. A modification inside the power supply would be needed.
- Pull one 6146. After all, 50 watts out from one tube is nearer to 10 watts than 100 watts out from two tubes. No, not a really serious proposal.
- Convert the PA from 6146 to 2E26. Both tubes have identical sockets. This may indeed work but needs a lot of further work, including modifications inside the KWM-2 and 516F-2 for a lower HV and much lower grid supply.

So, except for the 10 dB power pad, it turned out that there was no solution in sight that would easily meet a few obvious requirements:

- Clear limitation to a fixed output power level that can be proven.
- No adaptations or changes to transceiver and/or power supply that cannot be removed easily. Better no modifications at all.
- Adjustable reduced power level and ideally there should be an on-off switch
- Full utilization of the built-in ALC-driven Collins RF speech compressor to have some "punch" in the 10 watt signal.

I skipped the idea and put the search for a solution on the shelf. Then, one day when I was in a QSO, talking and watching the ALC meter go up and down, I suddenly realized that my 30L-1 was actually - via external ALC - controlling the power output of the KWM-2 to limit the drive to the four 811 tubes. There was the solution, already

built into the 30L-1. And even better, it was clearly marked “designed by Collins”. What more could I get?

In very short time I put together a small box with a few parts from the junk box, with the circuit I borrowed from the 30L-1. The circuit diagram is given in Fig. 1 and Fig. 2 shows a photograph of my first implementation.

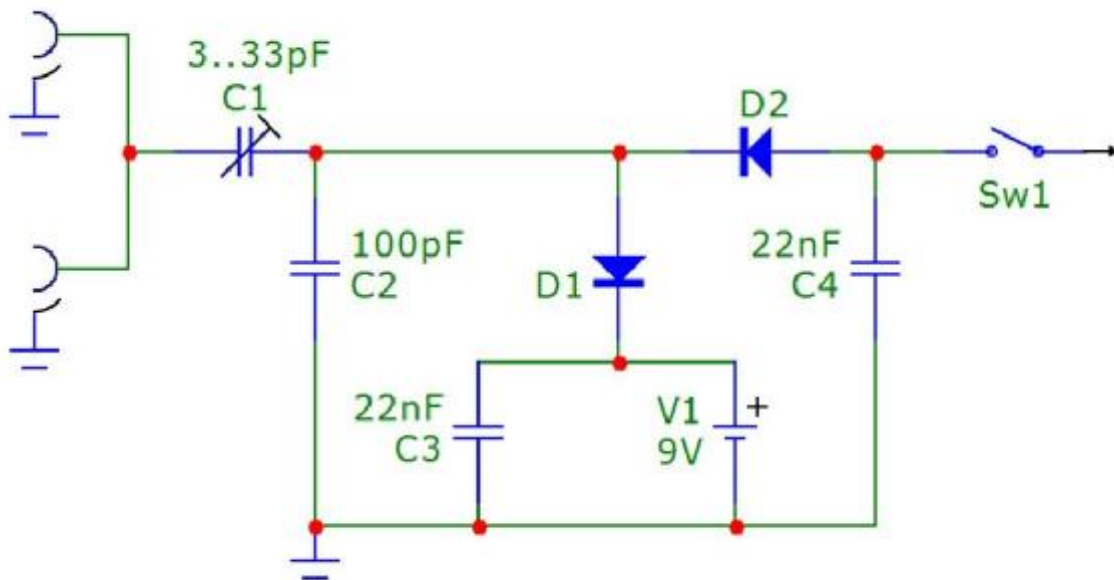


Fig. 1 **Circuit diagram of the power reduction adapter**

D1, D2	1N4148
V1	9V Block Battery
C1	Ceramic Trimmer 3..33 pF
C2	100 pF Silver Mica or similar
C3, C4	22 nF 250 V Disc Ceramic

The adapter box is placed into the KWM-2 output antenna line. An adjustable capacitive divider (C1/C2) senses the output RF voltage. Diodes D1 and D2 generate a negative voltage, that is bucked by V1, a 9 V block battery. The generated external ALC signal is fed into the KWM-2 ALC socket J4 via switch Sw1. Add two condensers for RF grounding, and that’s all.

Adjustment and use of this little circuit are very simple. You should have a dummy load, a two-tone generator and a PEP reading output meter. Put the little box into the antenna line and connect its output, first with Sw1 open, to J4 on the KWM-2. Tune up normally, then modulate with the two-tone signal and increase Mic Gain until you see 100 watts PEP output. The meter in ALC position will just start to move upwards. Now close Sw1. The PEP output will go down immediately and the ALC meter will jump to nearly full scale. Now you can adjust C1 for 10 watts PEP out. Finally replace the two-tone generator with your microphone and start talking. Watch the PEP meter with Sw1 open and closed, and listen to your signal on a second receiver, just to ensure that there is nothing strange going on.

That's it, problem solved, and all requirements met.

Any problems left over? Well, yes, the adapter circuit senses output voltage and therefore assumes that the KWM-2 is working into load reasonably close to 50 Ohms. When this is not the case then the limited power output can be higher or lower than 10 watts, but this is easily checked with a PEP reading VSWR meter in the output line to the antenna.

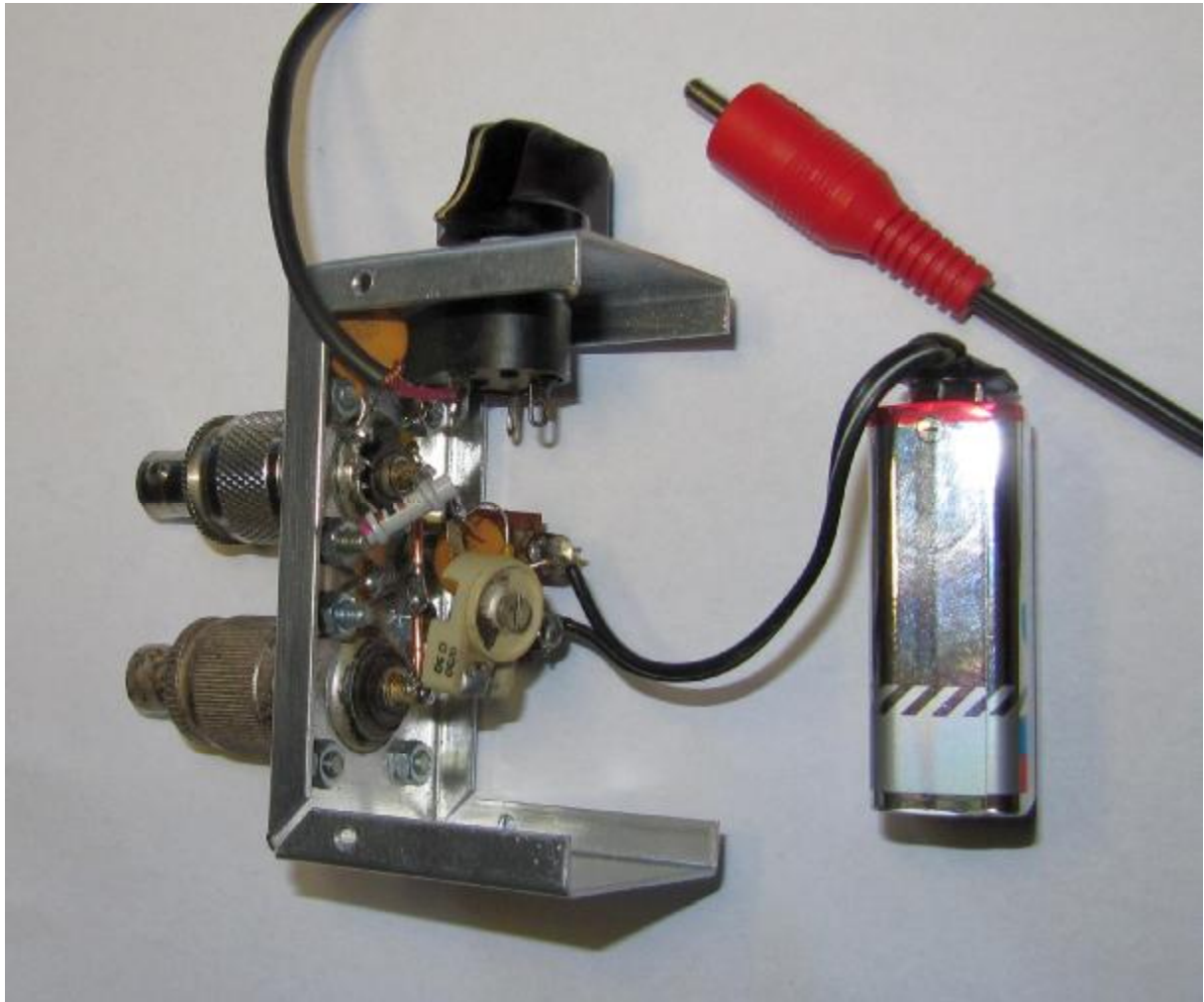


Fig. 2 View of the power reduction adapter, junk-box version

While I had been measuring the input-output transfer characteristic and intermodulation distortion of the KWM-2 for a different project, I also measured the characteristics with the power reduction adapter in place. These results are shown in Fig. 3.

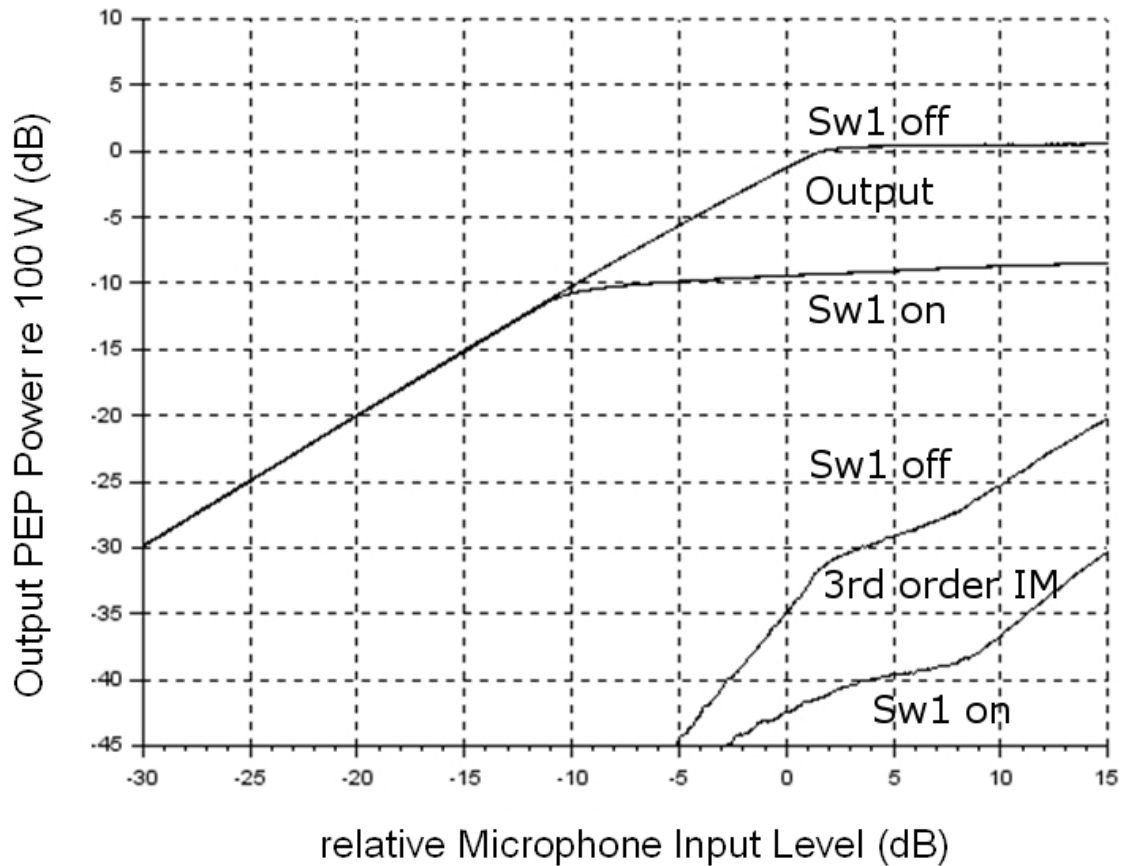


Fig. 3 Input-Output Characteristic and Intermodulation Distortion of a KWM-2 with power reduction adapter switched on and off

Figure 3 shows the input-output characteristic of a KWM-2 with a two-tone signal at the Microphone input. The input signal level was slowly swept from -30 dB to +15 dB in about 10 seconds. 0 dB corresponded to a level of 10 mV with Mic Gain set to 12 o'clock. For lower levels you can see a 10 dB linear increase in output power for the same 10 dB increase in microphone input level. When the output comes nearer to 100 watts, a bit larger input is needed. This "droop" is due to the limited power supply.

The output level is very well held near to 100 watts PEP due to the perfect ALC action with high loop gain, preventing grid current and keeping the 6146 tubes in AB1 mode all the time. Third order intermodulation distortion is always more than 30 dB down, up to a +4 dB input level, and clearly kept down by ALC action, even when the input signal rises to +10 dB and more.

With the power reduction adapter on, the output level is kept closely to -10 dB down from 100 watts PEP, that is to 10 watts PEP as intended. There is no droop. With only 10 watts out there is not that much demand on the power supply.

The output limiting characteristic is not as flat as the one for the KWM-2 without adapter, but still acceptable. This is due to the limited loop gain in the new external ALC circuit. Third order intermodulation distortion is also way down, even for high peaks in the input level.