

Measured Power Consumption of the Elecraft K3/100

(To run QRP or QRO on Batteries?)

Les Gasser, W9XC

V. 1.1

When contemplating the prospect of operating portable with batteries, it's useful to have a clear idea of power consumption choices so you can optimize both signal effectiveness and operating time. Most rig specification sheets show power requirements at full transmit output. Sometimes receiver power consumption figures are listed as well. But it is a bit difficult to find power consumption figures at fine-grained intermediate output power levels.

On the Elecraft K3 it's very easy to change output power in small increments by simply twisting a front-panel knob.

Accordingly, I hooked up my K3/100 to an ammeter and measured its total transmit power consumption in CW mode, at a variety of output power level settings up to 50 watts. The results are reported below.

A couple of items are worthy of note:

- These measurements were taken with the K3 set up as I normally use it in CW mode: display backlight on, AGC off, headphones, 500Hz CW filter in use, etc. (These mainly impact the receive power consumption.) I transmitted on 40 Meters into a 50 ohm dummy load, and did not check the power consumption on other bands.
- The K3/100 is a K3/10 with an additional 100W power amplifier, the KPA3 module. The K3/100 actually operates like a K3/10 when the output power adjustment is set to 12 Watts or below; the KPA3 seems to have minimal impact. When the output power adjustment is set above 12 Watts, the K3 automatically switches in the KPA3. Operation of the the KPA3 obviously incurs some baseline overhead, which can be seen clearly in the transition in power consumption from 4.3A at the 12 W setting, to 8.75A at 13W setting (see the graph below).
- From my measurements, the basic figure for the K3's average power consumption increase is 155-160ma per watt. From the 1W to 12W settings the average power consumption increase per watt is about 160ma $[(4.3-2.5)/11 = 160\text{ma}]$. From 13W to 50W the average power consumption increase per watt is close to that, at about 155ma $[(14.5-8.75)/(50-13) = 155\text{ma}]$. I didn't actually measure DC power consumption at the nominal maximum of 100 Watts output. Elecraft specifies ~22 amps, which agrees with a projection of the measurements below $[(155*50)+14.5 = 22.25\text{A}]$. Thus I assume the increase from 50-100 watts is basically linear at 155ma/watt.
- Extrapolating from the 12W to 13W figures, this means that the baseline KPA3 power need is about 4.3A (8.75-4.46). Operating above 13 watts will incur this overhead penalty, as shown in the graph. One evident implication is that at 12 watts, increasing power 1 watt to 13 watts *doubles* power consumption. Operating with batteries, this is probably not a propagation-effective thing to do because a 1 watt (.3db) increase in output power will have no appreciable effect on received signal strength, while halving the available battery time. From 12 watts, doubling the power output (3db increase) will incur a 250% increase in current draw (4.3A to 10.7A). From this perspective it makes sense to operate either at 12 watts or less, or at an output power (current consumption) that will make a significant impact in received signal strength, to "amortize" the cost of the KPA3 baseline current draw.

Clifton Labs has [reported on its measurements of the power efficiency of the K3](#) (i.e., RF output power for given DC input power). These are actual measurements of output power, not just the K3's own reported power settings that I was able to use. They also consider efficiency at a variety of different input voltage levels. This is useful when considering different types of power sources or drops in battery voltage with charge levels.

W1PNS, WA0ITP, and AB8XA have provided a very useful spreadsheet tool for computing battery capacity needs and expected battery usage time (see their "[Battery Estimator Spreadsheet](#)"). The figures below provide alot of useful information about the K3 that can be used in conjunction with that spreadsheet when planning portable battery powered (or otherwise power-limited) operations.

Results

Receive Current: 1.12 A

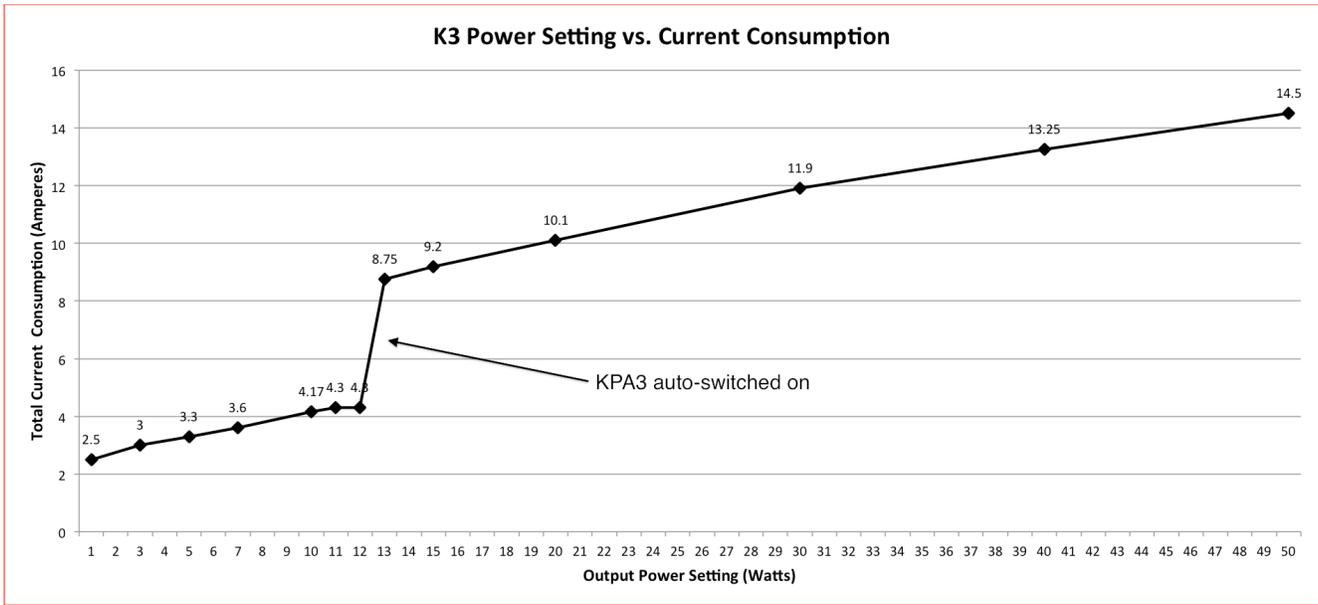


Table of Data: K3 Output Power Setting vs. Total Current Consumption (Transmit), on 40 Meters

Power Output Setting (Watts)	Current Consumption (Amperes)
1W	2.5A
3W	3.0A
5W	3.3A
7W	3.6A
10W	4.17A
11W	4.3A
12W	4.3A
13W	8.75A
15W	9.2A
20W	10.1A
30W	11.9A
40W	13.25A
50W	14.5A