The EEG Calibrator was measured with an Agilent 54622D 200MS/s Mixed Signal Oscilloscope and the following values obtained:

Setting	**Measured Freq**	**Setting**	**Measured Freq**
1	1.005	33	33.11
2	2.008	34	34.07
3	3.01	35	35.03
4	4.02	36	36.04
5	5.03	37	37.11
6	6.02	38	38.10
7	7.03	39	39.06
8	8.03	40	40.04
9	9.05	41	41.03
10	10.05	42	42.06
11	11.05	43	42.96
12	12.05	44	44.10
13	13.05	45	45.05
14	14.06	46	46.08
15	15.06	47	47.00
16	16.05	48	48.19
17	17.05	49	49.02
18	18.05	50	50.00
19	19.08	51	51.02
20	20.06	52	52.08
21	21.07	53	52.91
22	22.03	54	54.1
23	23.07	55	55.0
24	24.04	56	55.9
25	25.06	57	57.1
26	26.04	58	58.1
27	27.10	59	59.1
28	28.09	60	59.9
29	29.07	61	60.9
30	30.12	62	62.0
31	31.06	63	62.9
32	32.10	64	64.0

At 1Hz the output voltage was measured as 2.36Vpp and at 64Hz 2.20Vpp (using 2x 20K for R7 & 8, measured before the voltage divider.)

The voltage accuracy (due to the low pass filter response) thus is:

Vpp accuracy = (2.36 – 2.22) / 2.36 = 5.93%

The LPF was then modified by using 47nF, 2x 47nF & 15K components.

With these new components, the output voltage was found to be:

1Hz => 2.34 Vpp
64Hz => 2.29 Vpp
Vpp accuracy = (2.34 – 2.29) / 2.34 = 2.14%

But we need an output voltage of 2.002 Vpp, not 2.32 Vpp and should thus adjust the R7/R8 ratio. Calculations show that R7 = 1.3177 * R8

Thus use R7 = 23K7 and R8 = 18K

The following power supply measurements where taken:

During the battery test implementation it was decided to bypass the 1E8 resistor and the following consumption was obtained:

V_{INPUT} (with R1 = 0E)	**I_{BATT}**	**V_{OUTPUT}**
1.20V	15mA	4.85V
1.30V	14mA	4.85V
1.40V	12mA	4.85V
1.50V	11mA	4.85V

The function of resistor R1 is to limit the reverse polarity current when the battery is inserted the wrong way round. A value of 0 ohms would give the best battery life, but is not to be recommended. A value of up to about 10 ohms is OK, but remember that this resistor causes a voltage drop, and with 1.5V there is not exactly a lot of voltage to waste! I don't know what the short circuit current of an AA alkaline cell is; a resistor of 1E8 keeps the current within the 600mA peak of the BAT54.

The above currents where measured with low sine output frequency, as the output frequency rises, the consumption will also rise with a small margin. When operating in pulse mode, the internal op-amps are disabled and the consumption, although not measured, should plummet.

The inductor used for the above test was a 6.35mm outside diameter toroid, [Magnetics 55017-A2] with 6 turns, giving approx 3 to 4uH.

A 1.5V [AA] alkaline battery typically has a 600mAh to 950mAh rating.

Thus battery life = 600mAh/15mA (lets be conservative)
= 40 hours

If the circuit is changed to run from a 9V battery, a linear regulator with a better accuracy than a 78L05 should be used. For instance, Microchip's MCP1703 is specified to within 0.4% typical accuracy. Also remember to adjust the R7/R8 ratio when running at 5.0V – as seen in the above table, the TPS61070 gives 4.85 V with the specified resistors and the R7/R8 ratio was calculated based on this voltage. The idea was to use 180K, 560K & 1M (R2, R3 & R4) but as I did not have these exact values, I used 178K and 562K instead.

I have used the circuit to good effect during my own EEG hardware development, at the time of writing still on going. The one thing I am not sure of is my selection of output voltages. In my prototype, I changed R17 to 1 ohm for super low output amplitudes to investigate signal-to-noise, etc. The resistor divider is easy enough to re-calculate and change to give other output settings.

The pictures show that the voltage divider 0603s have not been populated and a temporary 22E soldered across the output. You will also see that although the "battery test" push button was fitted to the pcb, I was too lazy to fabricate an extension plunger and drill the extra hole into the box. If I want to check the battery I simply switch the unit off and then back on again.

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15 August 2008