P14418

Test comparing P14418's designed switching regulator to the regulator inside the current BWM model

What was tested: The efficiency of the switching regulator designed by P14418 is compared to the regulator inside the current BWM unit. Both regulators have been previously tested and are known to work fine. This test only measures whether one circuit has an advantage over the other. The test was conducted by connecting the input lead of the circuit directly to a power supply that displayed the voltage and current it was providing. Below are tables with all of the collected data.

Assumptions: Seen below there is a column labeled 'Pump on?'. When this column has a yes marked in it, this means the pump had already gone through its 5-10 second startup and was actually pumping water when the data was recorded.

Results:

P14418's switching regulator data:

Vin	V out @ Pump	Current Draw (A)	Pwr In (W)	Pwr Out (W)	Efficiency	Pump On
12	10.4	1.5	18	15.6	0.866667	No
13	11.6	1.52	19.76	17.632	0.892308	No
13.5	11.8	1.54	20.79	18.172	0.874074	No
14	12.4	1.55	21.7	19.22	0.885714	No
14.5	12.9	1.56	22.62	20.124	0.889655	No
15	13.4	1.56	23.4	20.904	0.893333	No
15.5	13.6	1.9	29.45	25.84	0.877419	Yes
16	14.2	1.92	30.72	27.264	0.8875	Yes
16.5	14.6	1.94	32.01	28.324	0.884848	Yes
17	15	1.94	32.98	29.1	0.882353	Yes
17.5	15	1.88	32.9	28.2	0.857143	Yes
18	15	1.84	33.12	27.6	0.833333	Yes
18.5	15	1.7	31.45	25.5	0.810811	Yes
19	15	1.67	31.73	25.05	0.789474	Yes
20	15	1.62	32.4	24.3	0.75	Yes

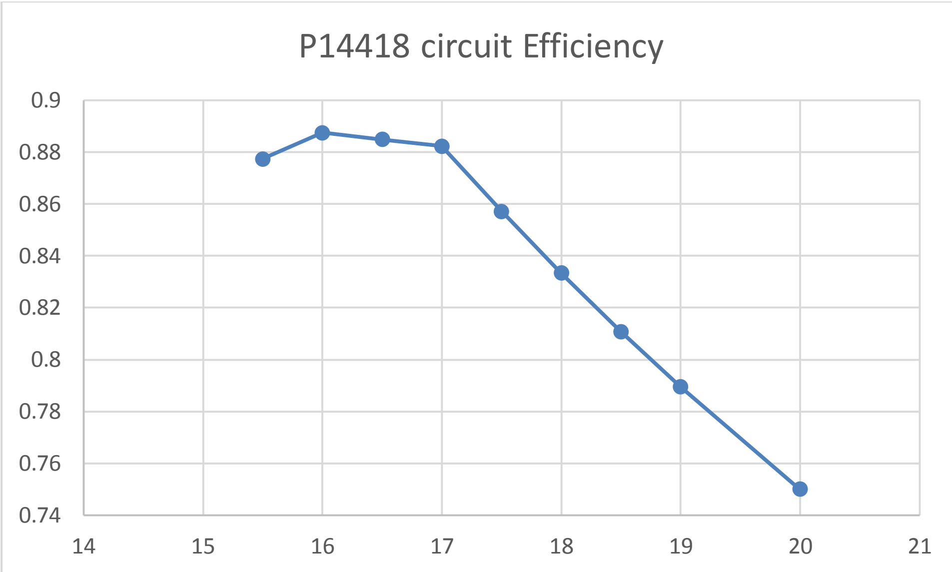

Figure 1: P14418's circuit efficiency.

B9's generator circuit:

Vin	V out @ Pump	Current Draw (A)	Pwr In (W)	Pwr Out (W)	Efficiency	Pump On
12	11	1.54	18.48	16.94	0.916666667	No
13	12	1.54	20.02	18.48	0.923076923	No
13.5	12.5	1.55	20.925	19.375	0.925925926	No
14	13	1.55	21.7	20.15	0.928571429	No
14.5	13.4	1.8	26.1	24.12	0.924137931	Yes
15	13.8	1.93	28.95	26.634	0.92	Yes
15.5	14.3	1.94	30.07	27.742	0.922580645	Yes
16	14.9	1.96	31.36	29.204	0.93125	Yes
16.5	15.3	1.97	32.505	30.141	0.927272727	Yes
17	14.7	1.97	33.49	28.959	0.864705882	Yes
17.5	14.6	1.96	34.3	28.616	0.834285714	Yes
18	14.6	1.96	35.28	28.616	0.811111111	Yes
18.5	14.6	1.96	36.26	28.616	0.789189189	Yes
19	14.5	1.96	37.24	28.42	0.763157895	Yes
20	14.5	1.96	39.2	28.42	0.725	Yes

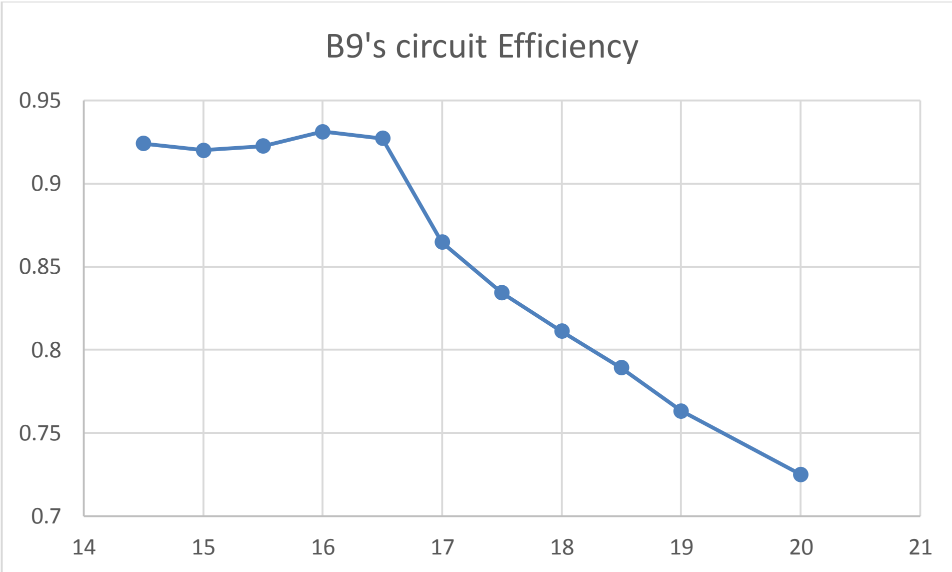

Figure 2: B9's circuit efficiency.

Discussion of Results:

The general trend is that for normal operating ranges, B9's circuit is around 4% more efficient when the input voltage is 14.5V-16.5V. Peak efficiency for B9's circuit in this range is 93%. Peak efficiency for P14418's circuit is 89%. It can be noted that P14418's circuit is more efficient for input voltages 16.5V and above. This is significant because 16.5V is an achievable input voltage from the user pedaling, so there will be extended periods when the system is operating with a 16.5V+ input. The difference in efficiencies is likely due to B9's circuit being specifically designed for this application. Other than being more efficient at higher input voltages, the only other advantage P14418's circuit has over B9's circuit is simplicity. The regulation portion of P14418's circuit consists of 5 components that are made by well-known manufacturers such as TI and Murata. A component cost analysis using price per 1000 will be completed and presented in another document to compare the costs of each circuit excluding fabrication cost.

Conclusion: B9's circuit is more efficient when the input voltage is 14.5V-16.5V. P14418's circuit is more efficient for 16.5V+. P14418's circuit is also simpler than B9's. So there are clearly some tradeoffs between the two circuits. As stated above, a component cost analysis will be completed to compare costs of the two circuits. All of this information will be unbiasely presented to the customer and they can decide which circuit to use.