Voltage Regulator Pulse Load Test Compilation

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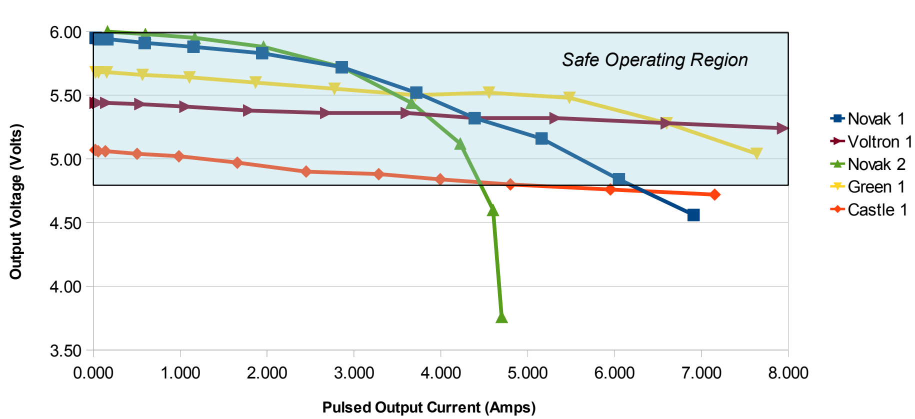
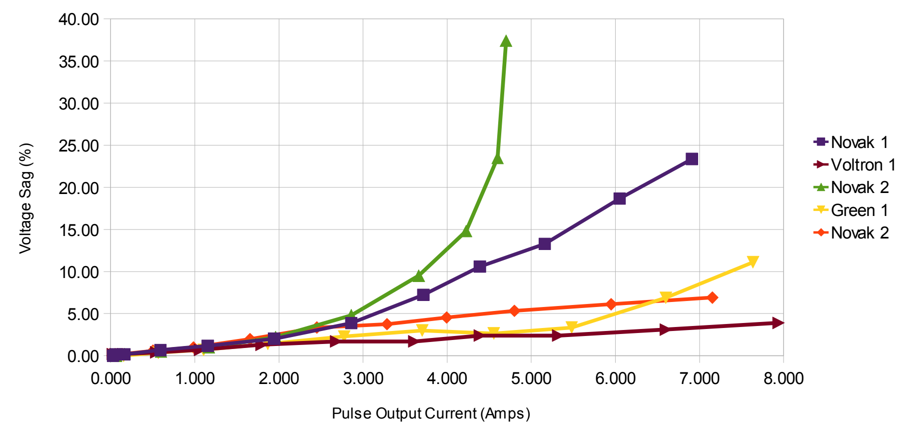
This critical test generates short high current demands such as those found in a typical 6-servo competition sailplane executing high-G maneuvers.
The ideal regulator in our application would be able to handle these transient loads with little voltage sag at the higher current levels. When comparing products pay particular attention to the **Voltage Regulator Pulse Load Performance** graph below: it allows you to visually compare how much output voltage each regulator can deliver to your plane at a given current load. If you know what minimum voltage your particular servos require for best performance (e.g. about 5.5v for MKS servos), you can see which regulators can deliver the most peak current at that voltage level. It is also suggested you read the section **Pulse Test Regulator Input Voltage versus Load Current** at the end of this spreadsheet for additional information about this test.

One other note on what to look for in the graphs below. The "flatter" the voltage versus current curve the better the regulation. For example, notice the "Voltron 1" attributes in the graphs below: they are very flat out to 8 amps—this is unusually good. Flat V-I curves reflect an ability to keep the output voltage more constant as load current increases. In the case of "Novak 1," after 3 amps it's clear the regulator is not as effective in maintaining a constant output voltage as some others. While the sagging voltage may stay in the "Safe Operating Region" depending on your plane servo's high current needs it may be a better value to go with a regulator with flatter V-I characteristics.

Graph 1: Voltage Regulator Pulse Load Performance



Graph 2: Pulse Load Voltage Sag (%)



Graph 3: Pulse Load Voltage Sag (Volts)

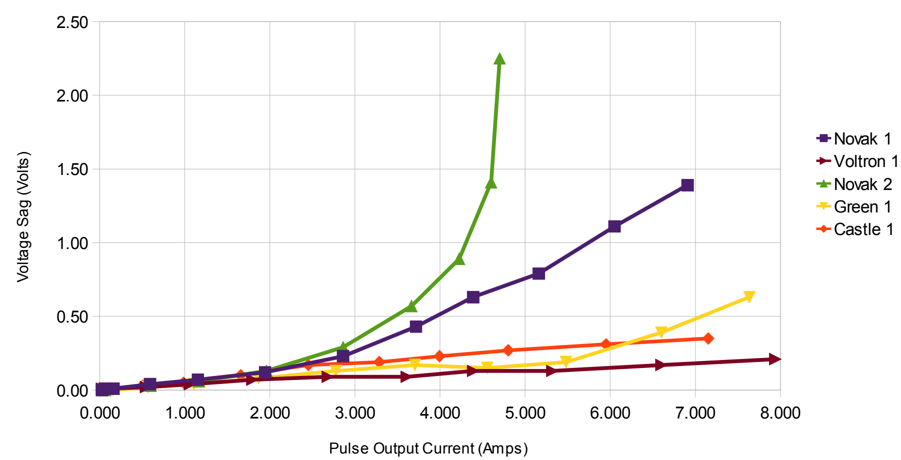


Table 1: Products Tested

Graph Name	Product Tested
Novak 1	Novak 5A Universal BEC #5465
Novak 2	Novak 3A Universal BEC #5460
Green 1	Greentronic RegSlim
Castle 1	Castle 10A CC BEC
Voltron 1	Voltron 6A 5.4v

Table 2: Regulator Test Results Data

Rload (ohms)	Vsag (v)	Vsag (%)	Vout (V)	Iload (A)	Vsag (v)	Vsag (%)	Vout (V)	Iload (A)	Vsag (v)	Vsag (%)	Vout (V)	Iload (A)	Vsag (v)	Vsag (%)	Vout (V)	Iload (A)	Vsag (v)	Vsag (%)	Vout (V)	Iload (A)
	Novak 1				Castle 1				Green 1				Novak 2				Voltron 1			
220	0.00	0.00	5.95	0.027	0.00	0.00	5.07	0.023	0.00	0.00	5.68	0.026	0.00	0.00	6.01	0.027	0.01	0.20	5.44	0.025
94	0.01	0.17	5.94	0.063	0.01	0.20	5.06	0.054	0.00	0.00	5.68	0.060	0.00	0.00	6.01	0.064	0.01	0.20	5.44	0.058
37	0.01	0.17	5.94	0.162	0.01	0.20	5.06	0.138	0.00	0.00	5.68	0.155	0.01	0.20	6.00	0.164	0.01	0.20	5.44	0.149
10	0.04	0.67	5.91	0.591	0.03	0.59	5.04	0.504	0.02	0.35	5.66	0.566	0.03	0.50	5.98	0.598	0.02	0.40	5.43	0.543
5.10	0.07	1.18	5.88	1.153	0.05	0.99	5.02	0.984	0.04	0.70	5.64	1.106	0.06	1.00	5.95	1.167	0.04	0.70	5.41	1.061
3.00	0.12	2.02	5.83	1.943	0.10	1.97	4.97	1.657	0.08	1.41	5.60	1.867	0.13	2.20	5.88	1.960	0.07	1.30	5.38	1.793
2.00	0.23	3.87	5.72	2.860	0.17	3.35	4.90	2.450	0.13	2.29	5.55	2.775	0.29	4.80	5.72	2.860	0.09	1.70	5.36	2.680
1.49	0.43	7.23	5.52	3.717	0.19	3.75	4.88	3.286	0.17	3.00	5.50	3.704	0.57	9.50	5.44	3.663	0.09	1.70	5.36	3.609
1.21	0.63	10.59	5.32	4.389	0.23	4.54	4.84	3.993	0.15	2.65	5.52	4.554	0.89	14.80	5.12	4.224	0.13	2.40	5.32	4.389
1.00	0.79	13.28	5.16	5.160	0.27	5.33	4.80	4.800	0.19	3.35	5.48	5.480	1.41	23.50	4.60	4.600	0.13	2.40	5.32	5.320
0.80	1.11	18.66	4.84	6.050	0.31	6.11	4.76	5.950	0.39	6.88	5.28	6.600	2.25	37.40	3.76	4.700	0.17	3.10	5.28	6.600
0.66	1.39	23.36	4.56	6.909	0.35	6.90	4.72	7.152	0.63	11.11	5.04	7.636					0.21	3.90	5.24	7.939

Notes:

1. Current load is actually not uniform across all regulators at a given load resistance due to the fact that their Vout is not set the same.

Pulse Test Regulator Input Voltage versus Load Current

The platform for this test uses a Hyperion 1450mAh LiFePO4 2S battery pack as the primary voltage source. We do this since we are testing to see how the voltage regulators will respond in the real world to high current servo transients when planes are powered by LiFe battery packs. It is important to understand that because of the internal resistance of battery pack cells and plane wiring, the delivered pack voltage will drop as the load current increases. Thus the high current pulse regulation performance is a product of the current limit characteristics <u>and</u> the voltage dropout characteristics of these regulators.

The following graph illustrates this drop with data taken from one of the actual tested regulators although this pack voltage versus current curve is essentially independent of the regulator being tested.

Graph 4: Regulator Input Voltage versus Load Current

for test platform LiFe 2S battery pack

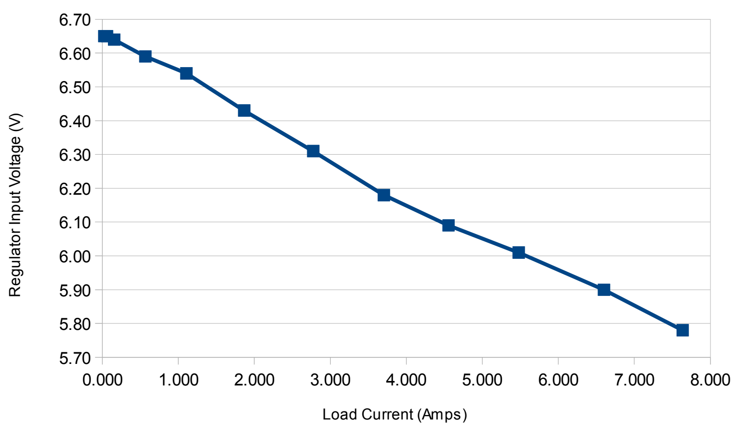


Table 3: Regulator Input Voltage Data

Vin	Vout (no load)	Vout (load)	Rload- ohms	Iload- A (calc)
6.65	5.68	5.68	220.00	0.026
6.65	5.68	5.68	94.00	0.060
6.64	5.68	5.68	36.60	0.155
6.59	5.68	5.66	10.00	0.566
6.54	5.68	5.64	5.10	1.106
6.43	5.68	5.60	3.00	1.867
6.31	5.68	5.55	2.00	2.775
6.18	5.67	5.50	1.485	3.704
6.09	5.67	5.52	1.212	4.554
6.01	5.67	5.48	1.000	5.480
5.90	5.67	5.28	0.800	6.600
5.78	5.67	5.04	0.660	7.636

Credits: These voltage regulator pulsed load tests were developed in close collaboration with **Mike Wilson** (RC Groups: Mike Wilson) who suggested the initial concept for these tests and then offered circuit implementation suggestions and refinements. These tests would not be anywhere as developed or useful without his expert guidance. Many thanks Mike!