Voltage Regulator Test Results

Test performed by: Chris Bajorek, RCG: SoaringDude
Test date: 02/08/2012 last update: 3-26-12 10:00am –added pulsed load test results

Product tested: **Castle 10A BEC**
Regulator type: Switching
Input voltage: 5-25v
Output voltage: 4.8-9.0v, adjustable (requires Castle Link USB accessory to adjust)
Load, continuous: 7A <12v input; 5A <24v input
Load, surge: 10A
Weight: 15g (mfgr says 11 g)
Dimensions: 30 x 15 x 10mm
Website: http://www.castlecreations.com
Regulator IC used: n/a
Minimum load current: n/a

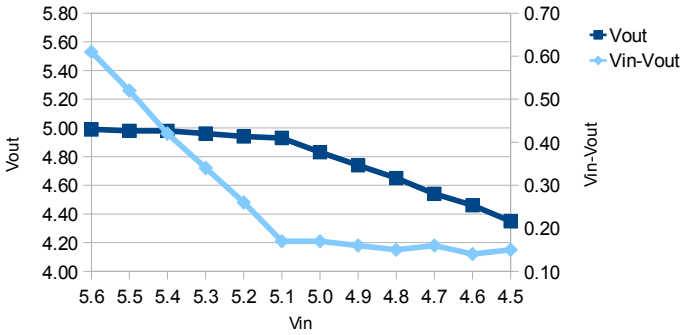
Product submitted by: Matt Blackman



Picture above: Voltage regulator size compared to a quarter and a 1450mAh LiFe 2S Hyperion battery pack.

Conditions set for all tests: Voltage regulator Vout =5.1v (factory default)

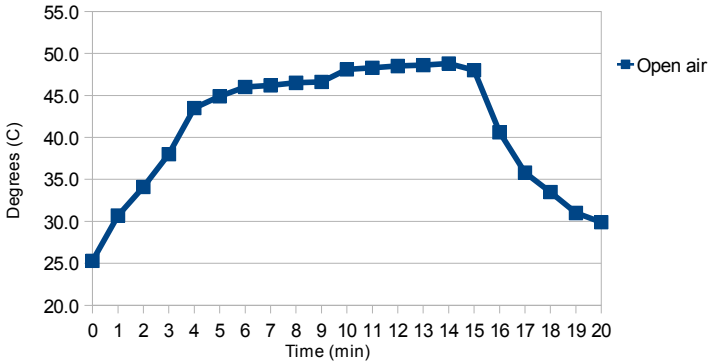
Graph 1: Low Voltage Dropout Characteristics, 0.9A load



DROPOUT PERFORMANCE: Very good. As Vin drops below 5.1 the regulator falls out of regulation while still delivering continuous voltage and current. Below dropout Vout was always ~0.15v less than Vin.

PROS: Can accept a wide input voltage range, excellent regulation performance, among the lowest cost regulators.

Graph 2: Thermal Performance, 1.6A load



THERMAL PERFORMANCE: Pass. At a constant load the temperature reached close to maximum within 5 minutes and substantially cooled with no load in about the same time. When we know what type of integrated circuit the regulator uses we can calculate how close to the thermal limit the device is coming; in this case we do not have that info.

PULSE LOAD PERFORMANCE: (for comparative pulse load test graphs see separate report elsewhere on RC Info Share). See test details below. This critical test generates short very high current demands such as those found in a typical 6-servo competition sailplane in high-G maneuvers The ideal regulator in our application could handle such loads with minimal voltage sag. While the Castle unit performed well with higher load currents we were unable to program this regulator for higher Vout levels since Castle was unresponsive after 3 attempts to obtain one of their USB accessories. Because of this their Vout is a bit too low for best performance of many servos. If you pay extra for the USB accessory and set the Vout to 5.6-5.8v, this has the potential to be a good regulator with high current high performance.

CONS: Being a switching unit the output voltage is a bit more noisy than linear units. However, this typically will not impact RC receivers and onboard equipment.

EFFICIENCY: at a nominal input voltage of 6.6v and an average current of 0.48A the regulator's efficiency is 84% (Output Pwr/Input Pwr). Note that with this regulator the factory default output voltage of this unit was set to 5.1v.

RF RADIATION (SWITCHING UNITS ONLY): Pass. Using a wideband triaxial RF meter that accurately measures radiated RF between 10mHz and 8gHz, at a distance of 4" no RF in that range was detected above the background level (with all nearby RF sources turned off). Caution is still prudent by placing as much distance between this regulator and your receiver.

CONCLUSION: The regulator did well with all tests except for the pulse load test since we were not able to raise the Vout level and observe performance at a higher output voltage. Our guess is that it would do well. Knowing that the Castle unit is switching-based we recommend providing as much distance between this regulator and your receiver—even though we did not measure any actual radiated RF from this unit.

Table 1: Quiescent Current Test

Vin	Iin- mA	Rload- ohms	Vout	Iout- mA	Pvr- mW		Conditions	Comments
7.0	19.3	none	5.07	0.0	134.75			Calculate VR power consumption with no load
6.6	19.4	none	5.07	0.0	128.04			

Table 2: High limit input voltage load test—short duration

Vin	Iin- A	Rload- ohms	Vout	Iout- A	Pvr- W	Eff.- %	Conditions	Comments
7.0	0.040	204.0	5.06	0.025	0.15	45%	30 seconds at each load	Pvr is power dissipated by VR unit
7.0	0.065	94.0	5.05	0.054	0.18	60%		
7.0	0.110	47.0	5.05	0.107	0.23	70%		
7.0	0.420	10.0	5.04	0.486	0.49	83%		
7.0	0.770	5.1	5.01	0.937	0.70	87%		
7.0	1.370	2.5	4.96	1.703	1.14	88%		

Table 3: Nominal input voltage load test—short duration

Vin	Iin- A	Rload- ohms	Vout	Iout- A	Pvr- W	Eff.- %	Conditions	Comments
6.6	0.041	204.0	5.06	0.025	0.14	47%	30 seconds at each load	Pvr is power dissipated by VR unit
6.6	0.067	94.0	5.06	0.054	0.17	62%		
6.6	0.115	47.0	5.05	0.107	0.22	71%		
6.6	0.440	10.0	5.04	0.485	0.46	84%		
6.6	0.800	5.1	5.01	0.936	0.59	89%		
6.6	1.440	2.5	4.96	1.699	1.08	89%		

Table 4: Low Vin dropout test

Vin	Iin- A	Rload- ohms	Vout	Iout- A	Vin-Vout		Conditions	Comments
5.6		5.1	4.99	0.933	0.61		Vout=5.1v	Keep in mind wiring provided by the VR vendor is also dropping some voltage. Also, the Vin range was changed to accommodate the lower default Vout of 5.1v
5.5			4.98	0.931	0.52			
5.4			4.98	0.930	0.42			
5.3			4.96	0.927	0.34			
5.2			4.94	0.923	0.26			
5.1			4.93	0.920	0.17			
5.0			4.83	0.903	0.17			
4.9			4.74	0.887	0.16			
4.8			4.65	0.869	0.15			
4.7			4.54	0.849	0.16			
4.6			4.46	0.834	0.14			
4.5			4.35	0.812	0.15			

Table 5: Thermal test: Open air

Time (min)	Vin	Iin- A	Rload-ohms	Vout	Iout- A	Temp- C		Conditions	Comments
0	6.8	1.62	2.5	4.88		25.3		Vout=5.1v	VR on table facing up. Using non-contacting infrared thermal probe pointed at hottest area of regulator that could be found.
1						30.7			
2						34.1			
3						38.0			
4						43.5			
5						44.9			
6						46.0			
7						46.2			
8						46.5			
9						46.6			
10						48.1			
11						48.3			
12						48.5			
13						48.6			
14						48.8			
15		0.01		5.07		48.0			Load disconnected here
16						40.6			
17						35.8			
18						33.5			
19						31.0			
20						29.9			

Date of test: 03/26/12

Table 6: Pulse Load test

Vin	Vout (no load)	Vout (load)	Rload-ohms	Iload- A (calc)	Vsag (v)	Vsag (%)	Vin - Vout(load)	Comments
6.64	5.07	5.07	220.00	0.023	0.00	0.00	1.57	Vbench set to 6.0v, Vbatt providing all voltage for pulsed load
6.63	5.07	5.06	94.00	0.054	0.01	0.20	1.57	
6.63	5.07	5.06	36.60	0.138	0.01	0.20	1.57	
6.59	5.07	5.04	10.00	0.504	0.03	0.59	1.55	
6.53	5.07	5.02	5.10	0.984	0.05	0.99	1.51	
6.45	5.07	4.97	3.00	1.657	0.10	1.97	1.48	
6.35	5.07	4.90	2.00	2.450	0.17	3.35	1.45	280mV p-p Vout noise
6.23	5.07	4.88	1.485	3.286	0.19	3.75	1.35	“
6.15	5.07	4.84	1.212	3.993	0.23	4.54	1.31	“
6.09	5.07	4.80	1.000	4.800	0.27	5.33	1.29	“
6.00	5.07	4.76	0.800	5.950	0.31	6.11	1.24	“
5.84	5.07	4.72	0.660	7.152	0.35	6.90	1.12	“

Pulse Load test notes:

1. A range of loads were “pulsed” on and off to simulate real world hi-g servo loads using an actual LiFe 2S battery pack.
2. Target currents range from 30mA to as high as 9A depending on where the regulator's Vout was set (lower Vout's yield lower load currents).
3. Vin = input v to regulator, Vout=output v from regulator.
4. Vin drops as load current increases due to the 1450mAh LiFe battery internal resistance.
5. Vin in the results table above is measured during a brief period when each load is manually switched on.
6. Vout measurements are taken from captured digital storage oscilloscope traces during load pulsing.

Pulse Load Digital Storage Scope Screenshots:

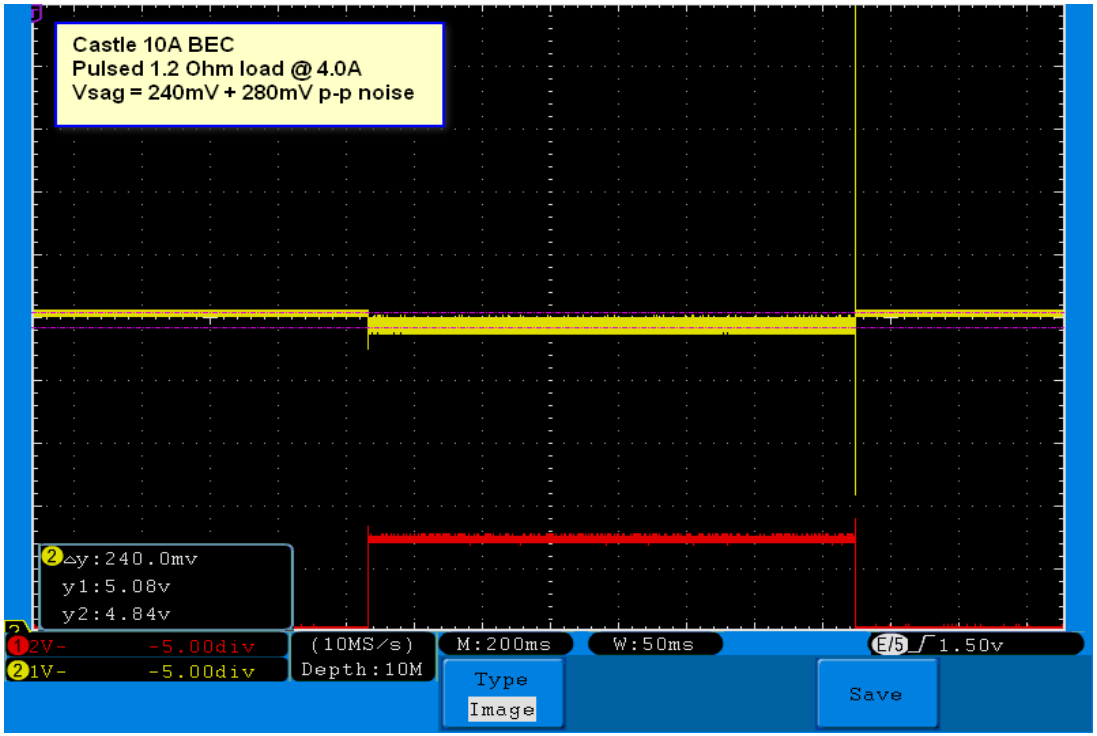
Notes:

Yellow trace = Vout from regulator

Red trace = Load ON pulse signal

Screen 1:





Note that the voltage spikes seen on the leading and trailing edges of the load pulses are due to the fast load switching from the test bed MOSFETS and are not issues with the regulator.

Screen 2:

