Power Swap – Buck-Boost

Specifications

	Min	Max
Supply Voltage	3	3.8
Current		500mA
Ouput Voltage		3.3

- Constant output voltage over a range of input voltage

- Max 500mA

Description

The Power Swap – Buck Boost module provides a convenient way to supply a constant 3.3V from a lithium ION battery.
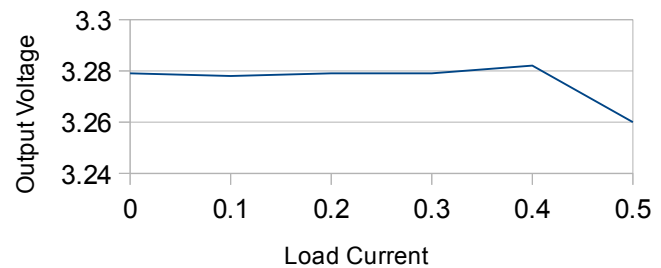
Test Results

Constant Supply

The test results show the behaviour of the system with a constant supply voltage and varied load from 0 through to 500mA. The system load represents the current drawn by the system as reported on the laboratory power supply.

Input Voltage 3.2V

Load Current	Output Voltage	System Load
0.000	3.279	0.005
0.100	3.278	0.113
0.200	3.279	0.230
0.300	3.279	0.375
0.400	3.282	0.530

Output Voltage by Load @ 3V2 (Boost)

Input Voltage 3.8V

Load Current	Output Voltage	System Load
0.000	3.279	0.005
0.100	3.279	0.091
0.200	3.279	0.185
0.300	3.279	0.291
0.400	3.280	0.408
0.500	3.283	0.533

Ouput Voltage by Load @ 3V8 (Buck)
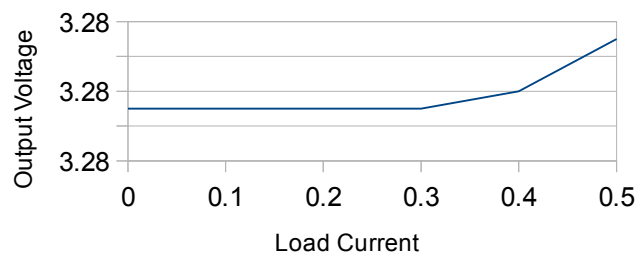
System Test

The results show the behaviour of a full system test. This is the Power Swap Buck-Boost module being supplied by the Full Charge Ahead (FCA) module, which is also charging a Lithium ION battery. An active load will be simulated using the Current Sink or Swim (CSoS) module.

The idea is to ascertain how the system will behave over time under load with no charge and then again with a constant charge from the FCA module.

Set up

The modules are interconnected as per the diagram below. The CSoS acts as an active load drawing current from the Li-ION cell via the Power Swap Buck-Boost module. It is expected that the CSoS is delivered the required current at a constant voltage of 3.3V.

Expected Behaviour

When the system is supplied from an external source i.e. 5V supply via the USB connector, it is expected that there should be no variation in the behaviour of the system. Once the 5V supply is removed (on a fully charged system) no immediate change is expected from the perspective of the active load. The system will deliver the required current at the constant 3.3V.

After some time, the Lithium-ION cell will reduce its output voltage in the range from 4.2V down to about 3.2V before shutting off entirely. During this, the Power Swap Buck-Boost module will switch from Buck mode to Boost mode to continue to deliver the required current at 3.3V.
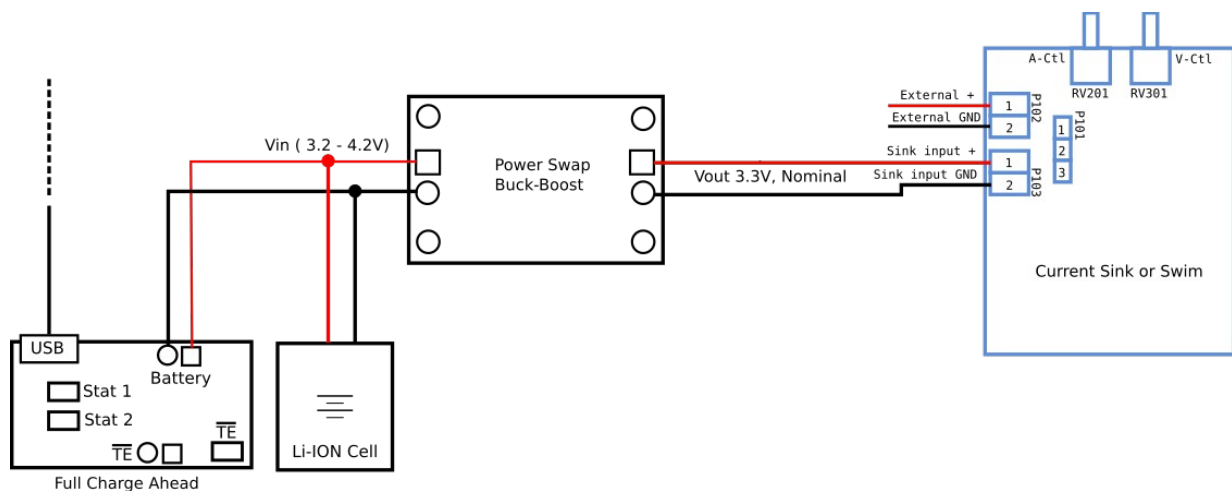
Results

Discharge

A constant load of approximately 60mA is applied using the CSoS. The battery voltage and Power Swap output voltage is measured at 5minute intervals.

Time	Battery Voltage	PS Output Voltage	Load	
00:00	4.180		0.121	0.000
00:05	4.080		3.279	0.060
00:10	4.080		3.279	0.060
00:15	4.060		3.279	0.060
00:20	4.040		3.279	0.050
00:25	4.020		3.279	0.060
00:30	4.000		3.279	0.060
00:35	3.990		3.279	0.050
00:40	3.960		3.279	0.050
00:45	3.930		3.279	0.050
00:50	3.900		3.278	0.050
00:55	3.880		3.278	0.060
01:00	3.870		3.279	0.060
01:05	3.860		3.279	0.050
01:10	3.840		3.278	0.050
01:15	3.830		3.279	0.060
01:20	3.820		3.279	0.050
01:25	3.800		3.278	0.060
01:30	3.790		3.278	0.050
01:35	3.780		3.278	0.050
01:40	3.770		3.278	0.060
01:45	3.760		3.278	0.060
01:50	3.750		3.278	0.060
01:55	3.740		3.278	0.060
02:00	3.730		3.279	0.060
02:05	3.730		3.278	0.060
02:10	3.720		3.278	0.060
02:15	3.710		3.278	0.060
02:20	3.700		3.279	0.060
02:25	3.690		3.278	0.060
02:30	3.680		3.279	0.060
02:15	3.670		3.278	0.060
02:20	3.660		3.278	0.060
02:25	3.660		3.278	0.060
02:30	3.650		3.279	0.060
02:15	3.640		3.278	0.050
02:20	3.630		3.279	0.060
02:25	3.620		3.278	0.060
02:30	3.610		3.278	0.060
02:15	3.600		3.278	0.050
02:20	3.570		3.279	0.060
02:25	3.490		3.278	0.060
02:30	3.360		3.278	0.060
02:15	3.040		3.278	0.050
02:20	0.000		0.000	0.000
02:25	1.280		0.000	0.000
02:30	1.300		0.000	0.000

## Buck-Boost over time

Discharge
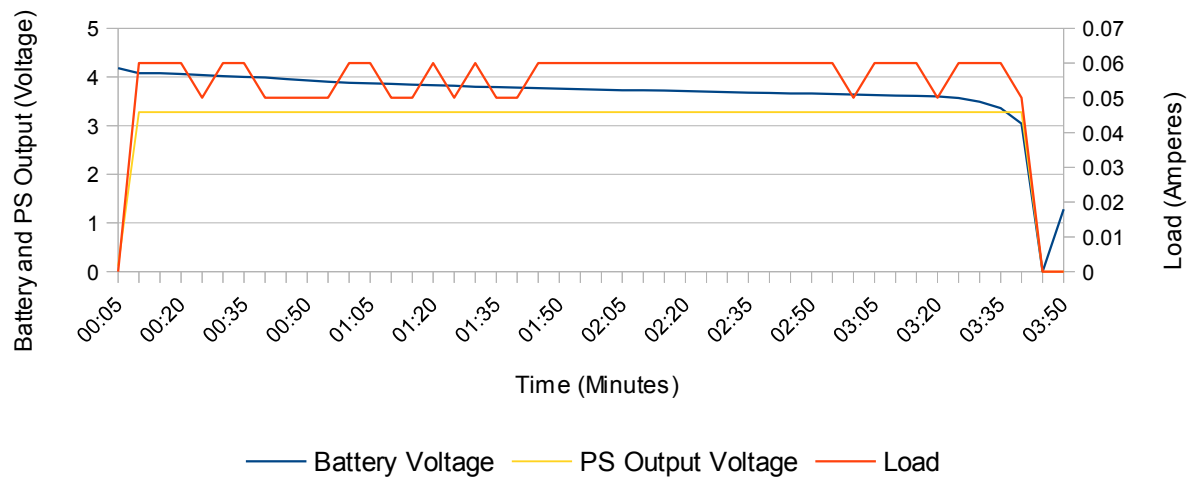
Recharge

The USB supply was added to the system. It was found that neither the CSoS or Power Swap could be connected to the system to enable the battery to be charged.

Time	Battery Voltage	PS Output Voltage	Load	System Load	
00:00	0.061		0.061	0.000	0.000
00:05	1.630		3.278		0.020
00:10	1.600		3.276		0.020
00:15	1.600		3.278		0.020
00:20	1.610		3.275		0.020
00:25	1.620		3.278		0.020
00:30	1.610		3.275		0.020
00:35	1.600		3.274		0.020
00:40	1.590		3.276		0.020
00:45	1.620		3.277		0.020
00:50	1.620		3.278		0.020
00:55	1.610		3.276		0.020
01:00	1.610		3.278		0.020
01:05	3.670		0.021		0.110
01:10	3.820		0.009		0.110
01:15	3.850		0.006		0.110
01:20	3.880		0.005		0.110
01:25	3.900				0.110
01:30	3.920				0.110
01:35	3.930				0.110
01:40	3.940				0.110
01:45	3.950				0.110
01:50	3.960				0.110
01:55	3.980				0.110
02:00	4.000				0.110
02:05	4.030				0.110
02:10	4.060				0.110
02:15	4.080				0.110
02:20	4.100				0.110
02:25	4.130				0.110
02:30	4.170				0.100
02:35	4.180				0.080
02:40	4.180				0.070
02:45	4.180				0.050
02:50	4.190				0.050
02:55	4.190				0.040
03:00	4.190				0.030
03:05	4.190				0.030
03:10	4.190				0.020
03:15	4.190				0.020
03:20	4.190				0.020
03:25	4.180				0.010
03:30	4.180				0.010

Buck-Boost over time

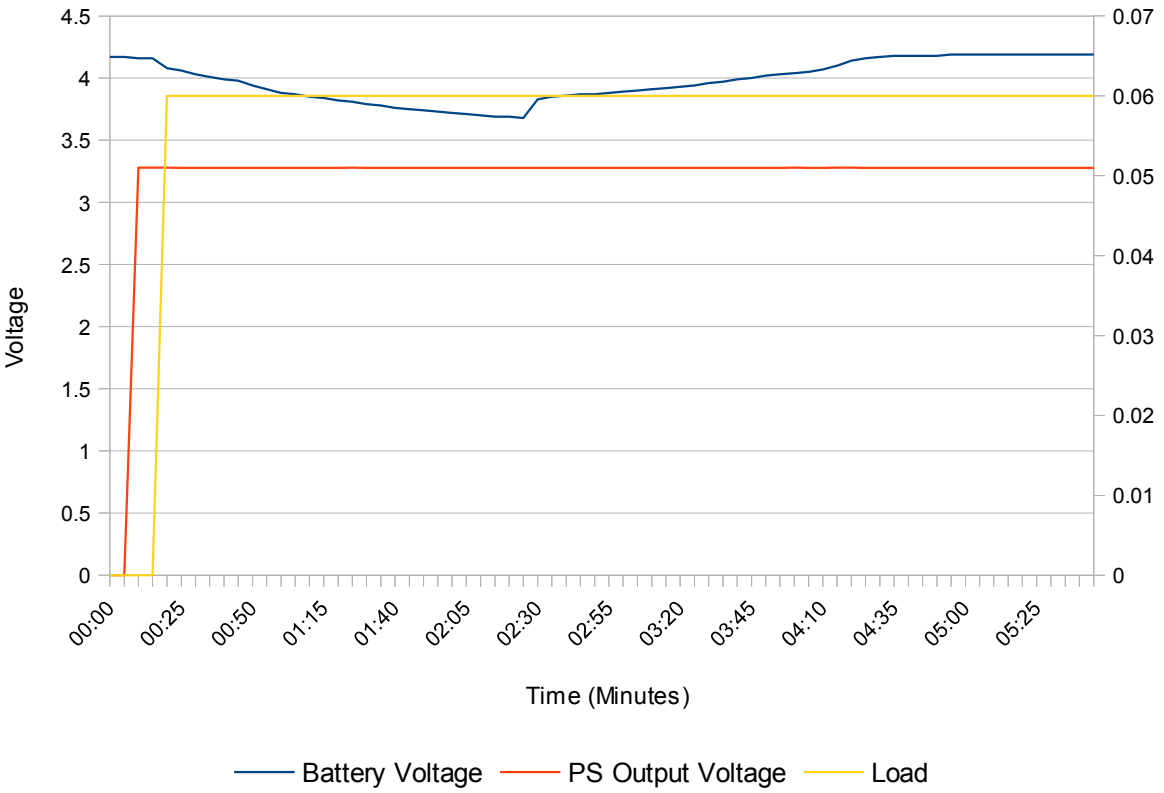### Recharge
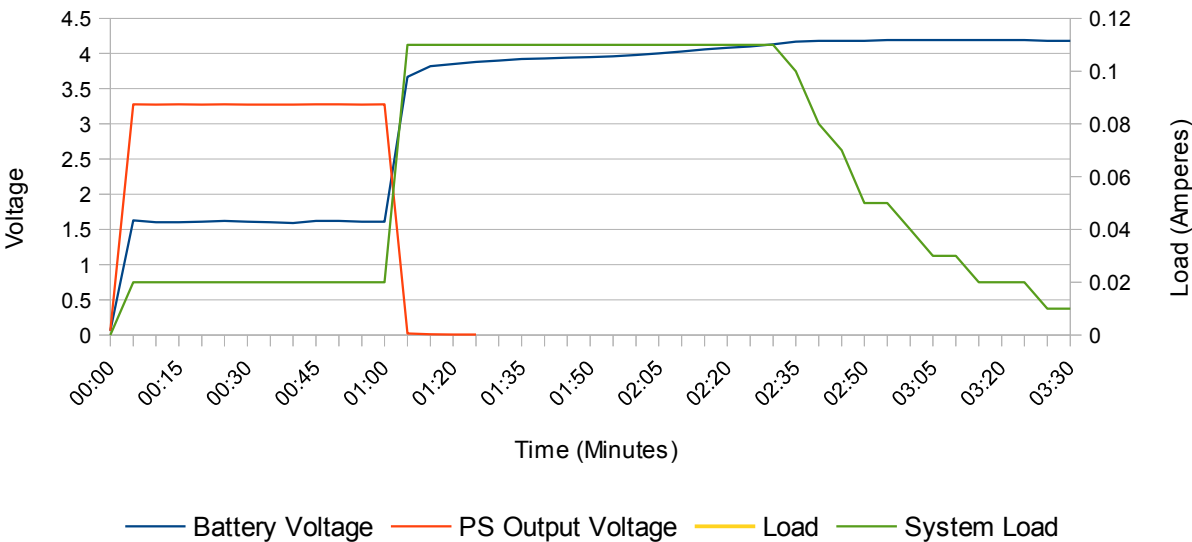
Recharge Under Load

It was found during the recharge that the a completely depleted battery can not be effectively charged with the FCA with the Power Swap or CSoS connected. A further test is performed here to check the behaviour of the system when the batter is not completely depleted.

The results show that it is possible for the FCA to charge the battery and supply the System. However, the FCA will not indicate that the battery is fully charged – only when removing the Power Swap from the system will the FCA indicate a fully charged battery.
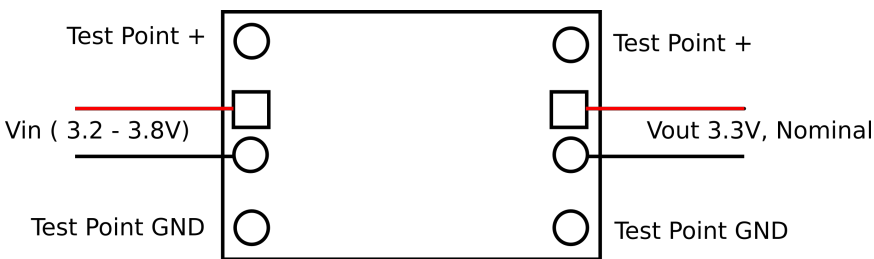
Time	Battery Voltage	PS Output Voltage	Load	
00:00	4.170	0.000	0.000	
00:05	4.170	0.000	0.000	
00:10	4.160	3.279	0.000	
00:15	4.160	3.279	0.000	
00:20	4.080	3.279	0.060	
00:25	4.060	3.278	0.060	
00:30	4.030	3.278	0.060	
00:35	4.010	3.278	0.060	
00:40	3.990	3.278	0.060	
00:45	3.980	3.278	0.060	
00:50	3.940	3.278	0.060	
00:55	3.910	3.278	0.060	
01:00	3.880	3.278	0.060	
01:05	3.870	3.278	0.060	
01:10	3.850	3.278	0.060	
01:15	3.840	3.278	0.060	
01:20	3.820	3.278	0.060	
01:25	3.810	3.279	0.060	
01:30	3.790	3.278	0.060	
01:35	3.780	3.278	0.060	
01:40	3.760	3.278	0.060	
01:45	3.750	3.278	0.060	
01:50	3.740	3.278	0.060	
01:55	3.730	3.278	0.060	
02:00	3.720	3.278	0.060	
02:05	3.710	3.278	0.060	
02:10	3.700	3.278	0.060	
02:15	3.690	3.278	0.060	
02:20	3.690	3.278	0.060	
02:25	3.680	3.278	0.060	
02:30	3.830	3.278	0.060	
02:35	3.850	3.278	0.060	
02:40	3.860	3.278	0.060	
02:45	3.870	3.278	0.060	
02:50	3.870	3.278	0.060	
02:55	3.880	3.278	0.060	
03:00	3.890	3.278	0.060	
03:05	3.900	3.278	0.060	
03:10	3.910	3.278	0.060	
03:15	3.920	3.278	0.060	
03:20	3.930	3.278	0.060	
03:25	3.940	3.278	0.060	
03:30	3.960	3.278	0.060	
03:15	3.970	3.278	0.060	
03:20	3.990	3.278	0.060	
03:25	4.000	3.278	0.060	
03:30	4.020	3.278	0.060	
03:15	4.030	3.278	0.060	
03:20	4.040	3.279	0.060	
03:25	4.050	3.278	0.060	
03:30	4.070	3.278	0.060	
03:15	4.100	3.279	0.060	
03:20	4.140	3.279	0.060	
03:25	4.160	3.278	0.060	
03:30	4.170	3.278	0.060	
03:35	4.180	3.278	0.060	
03:40	4.180	3.278	0.060	
03:45	4.180	3.278	0.060	
03:50	4.180	3.278	0.060	
03:55	4.190	3.278	0.060	
04:00	4.190	3.278	0.060	
04:05	4.190	3.278	0.060	
04:10	4.190	3.278	0.060	
04:15	4.190	3.278	0.060	
04:20	4.190	3.278	0.060	

Power Swap Buck-Boost

Recharge under Load

Time (Minutes)

— Battery Voltage   — PS Output Voltage   — Load

Connection

Test Point +

Test Point +

Vin (3.2 - 3.8V)

Vout 3.3V, Nominal

Test Point GND

Test Point GND

Schematic

P6
TST

P7
TST

2.2µH
L1

P5
TST

P8
TST

TPS63030

L1 4 | L1   L2 | 2 L2

Battery
P1
4V2 – 3V2
1
2

Vin+ 5 | Vin   Vout | 1 Vout+

Vout
P2
3V3
1
2

Vina 8 | VINA

C1
4.7µF

R3
0

EN 6 | EN   FB | 10 Feedback

Vin–

R4
0

P9
TST

Vout–

P3
TST

P4
TST

PS 7 | PS/SYNC

R5
0

GNDPWR

C4
0.1µF

9 | GND EP PGND | 3

U1

11

R1
1.2MΩ

C2
22µF

GNDPWR

GNDPWR

GNDPWR

R2
15KΩ

GNDPWR