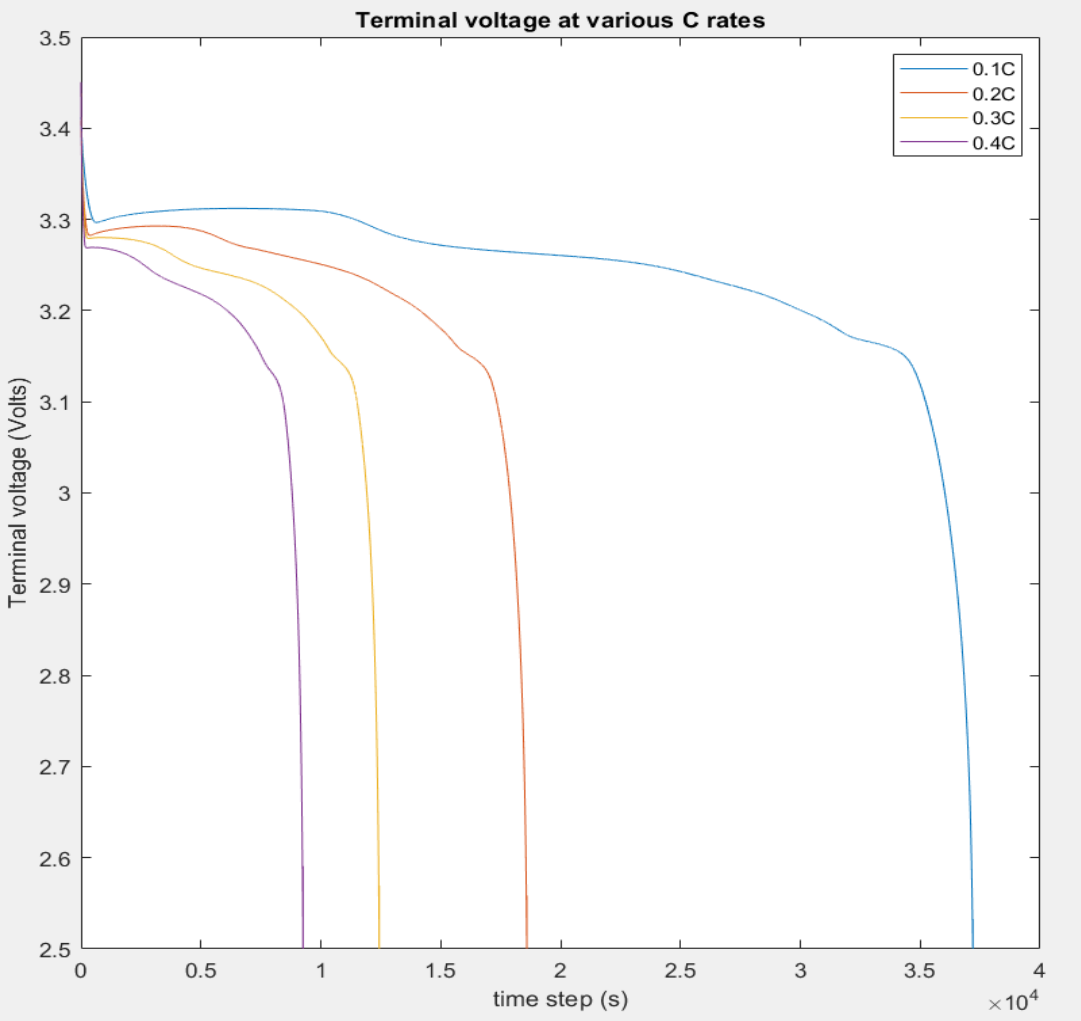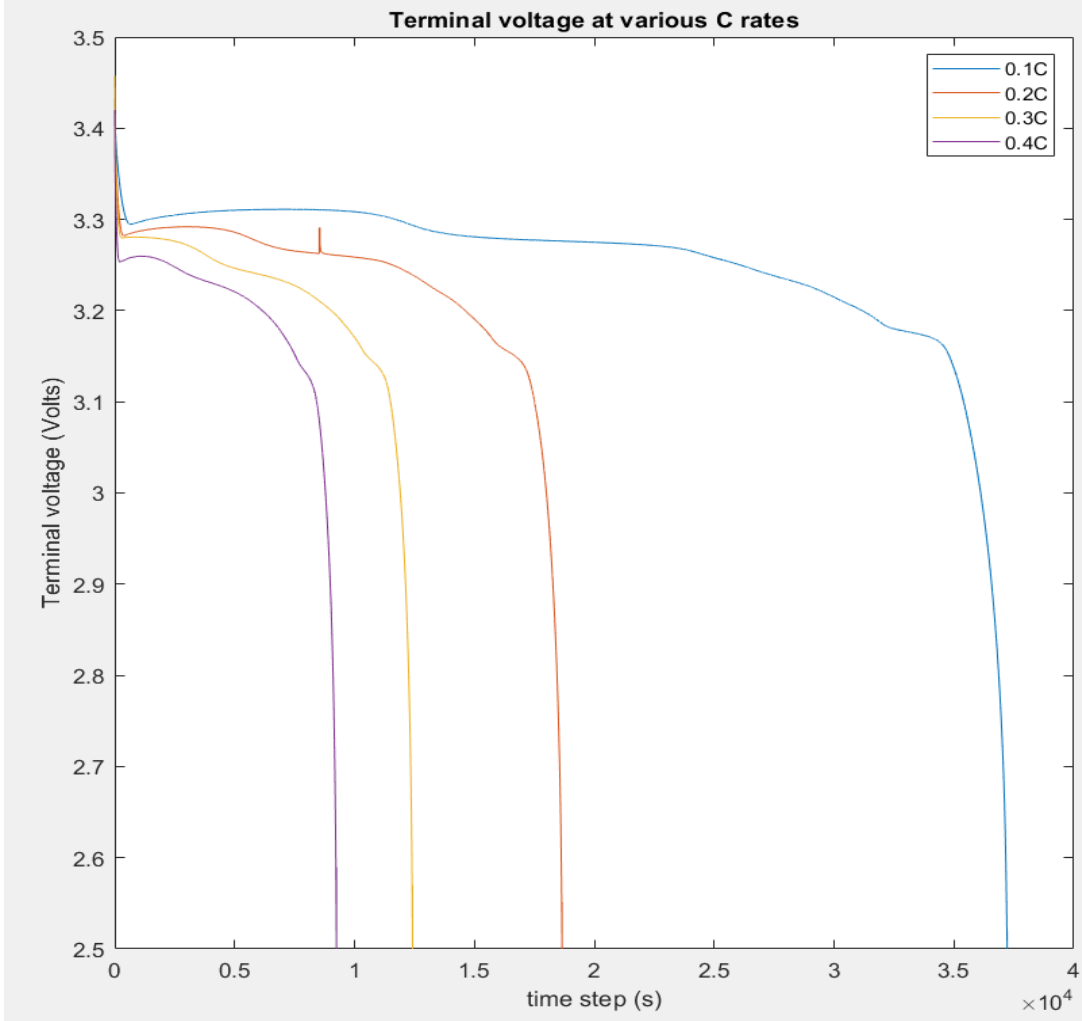# Static Test Analysis

Static Test performed and data shared

- 0.1C->Charge-Discharge
- 0.2C->Charge-Discharge
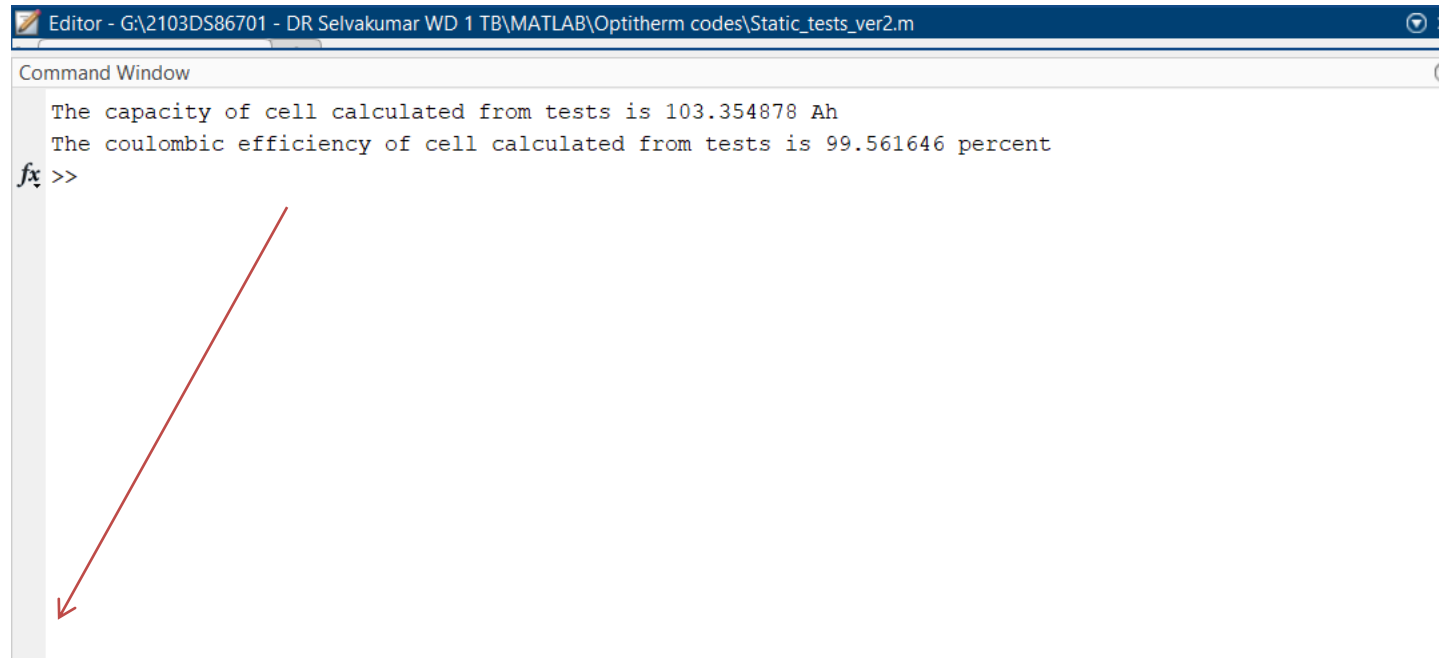- 0.3C->Charge-Discharge
- 0.4C->Charge-Discharge

Comment: At lower C rates, the deviation between terminal voltage and OCV is minimum. Therefore we take the test data of 0.1C rate for further analysis

Objective of the Test

To calculate following parameters from the test data shared:

- Columbic efficiency
- Current Capacity
- Calculation of Open Circuit Voltage (OCV) vs SOC

```
Editor - G:\2103DS86701 - DR Selvakumar WD 1 TB\MATLAB\Optitherm codes\Static_tests_ver2.m

Command Window
    The capacity of cell calculated from tests is 103.354878 Ah
    The coulombic efficiency of cell calculated from tests is 99.561646 percent
fx >>
```

❑ Cell Capacity: 103.35Ah
❑ Columbic Efficiency: 99.56%

Objective of the Test

To calculate following parameters from the test data shared:

- Columbic efficiency
- Current Capacity
- Calculation of Open Circuit Voltage (OCV) vs SOC

❑ Cell Capacity: 103.35Ah
❑ Columbic Efficiency: 99.56%

Objective of the Test

To calculate following parameters from the test data shared:

- Columbic efficiency
- Current Capacity
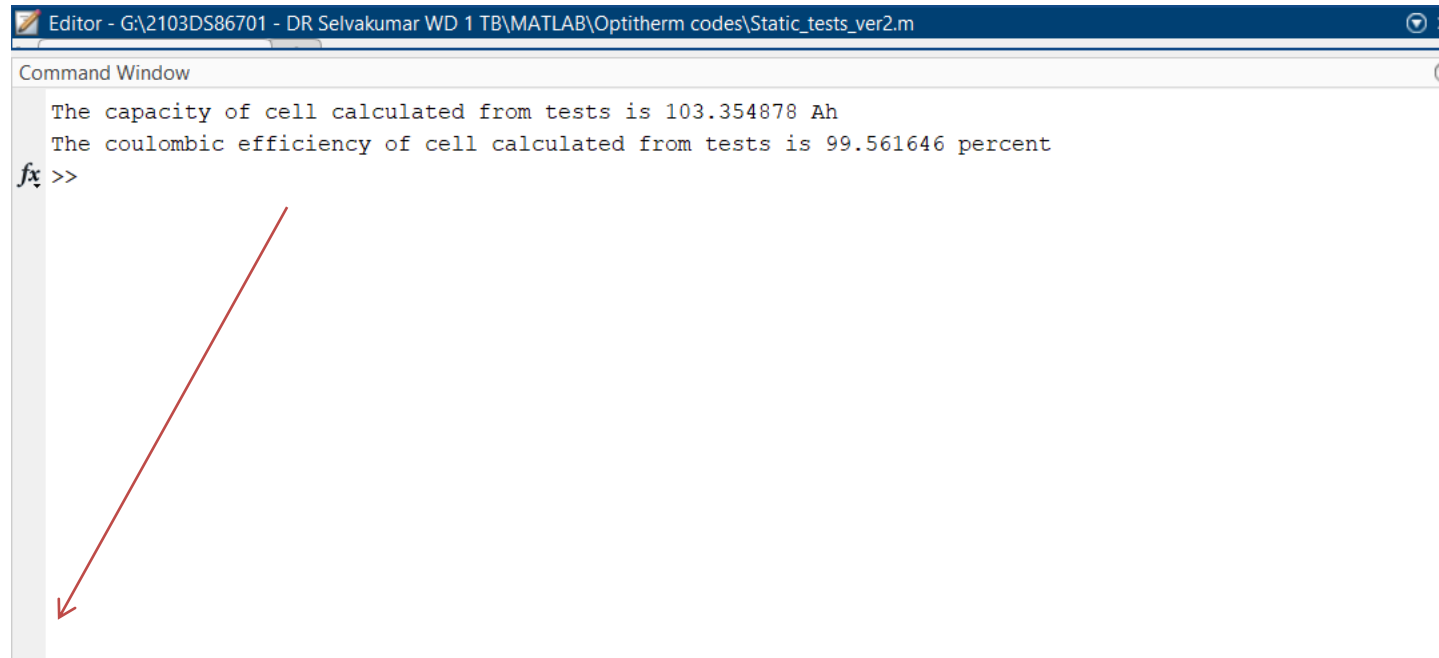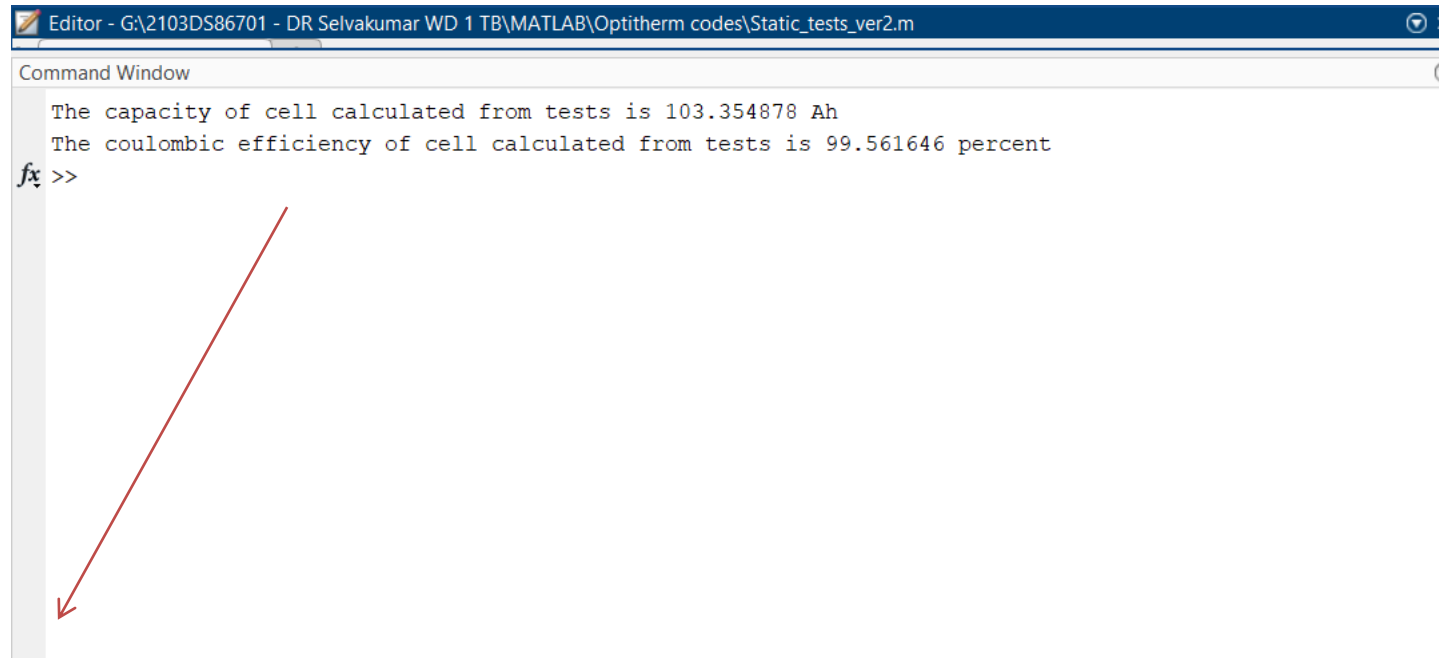- Calculation of Open Circuit Voltage (OCV) vs SOC

Editor - G:\2103DS86701 - DR Selvakumar WD 1 TB\MATLAB\Optitherm codes\Static_tests_ver2.m

Command Window

```
The capacity of cell calculated from tests is 103.354878 Ah
The coulombic efficiency of cell calculated from tests is 99.561646 percent
fx >>
```

❑ Cell Capacity: 103.35Ah
❑ Columbic Efficiency: 99.56%

Cycle 1 of 0.1C Data Analysis
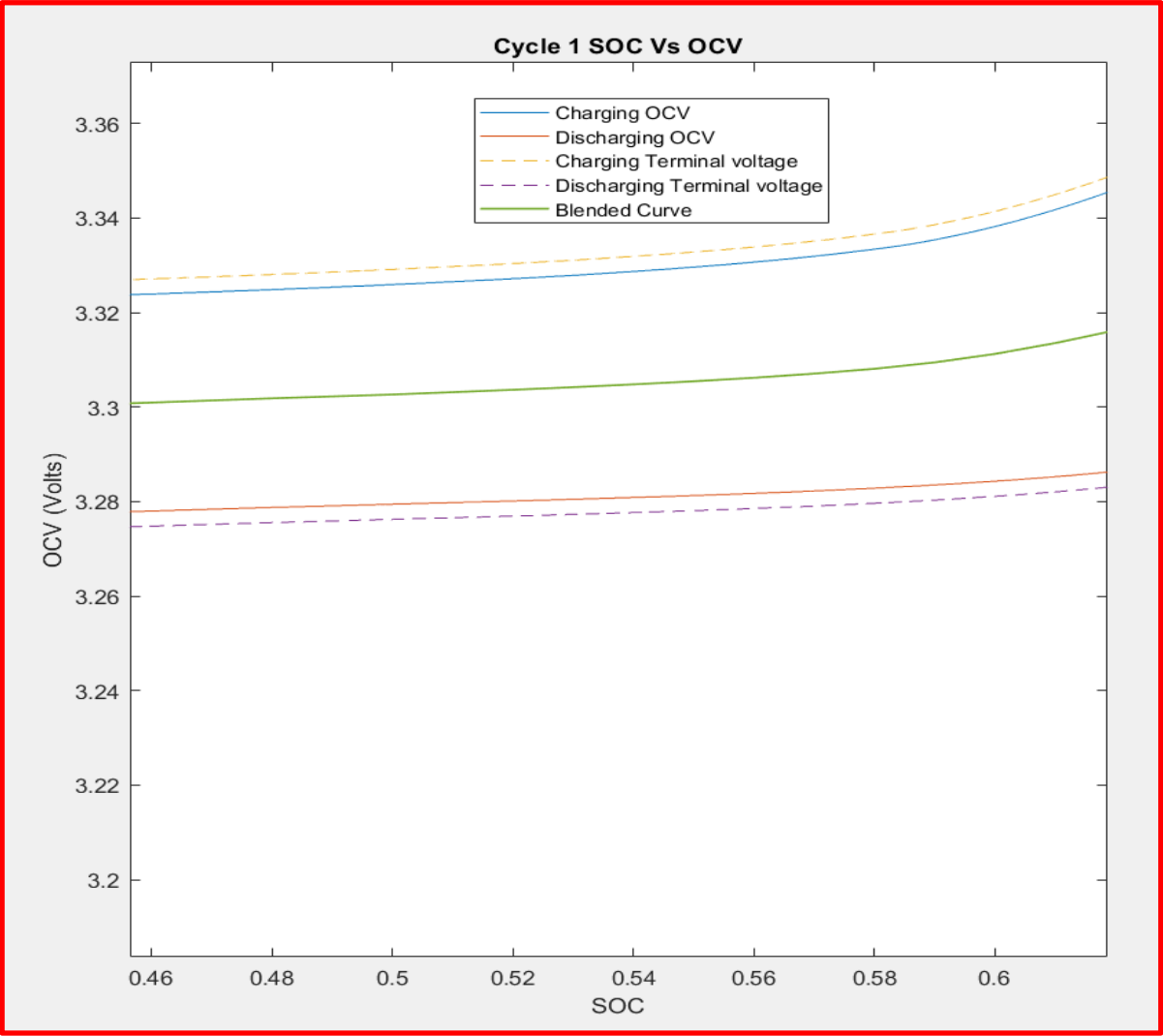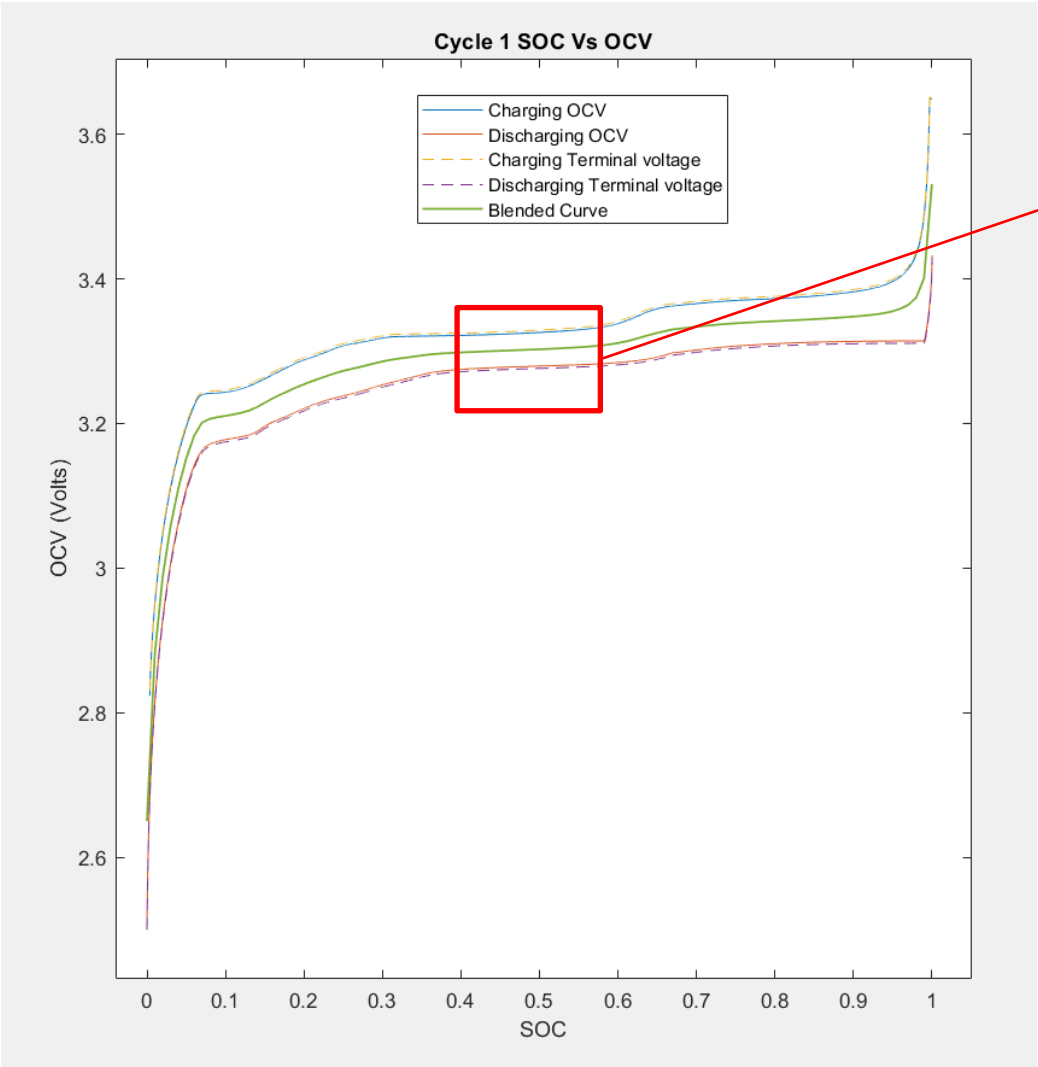
Comments: OCV is calculated by adding impedance factor and blending the charge-discharge graphs of 0.1C rate for cycle 1

Cycle 2 of 0.1C Data Analysis
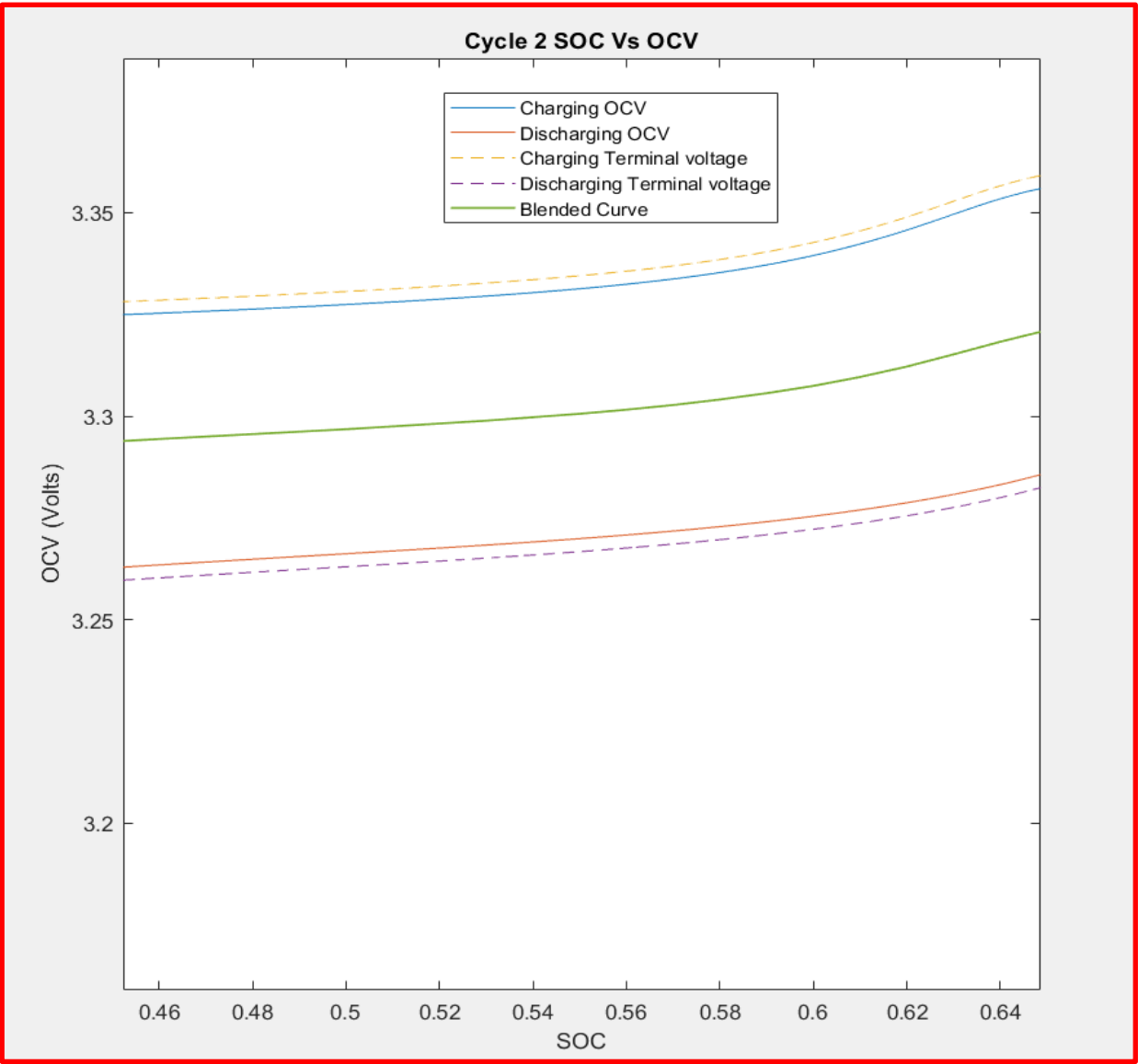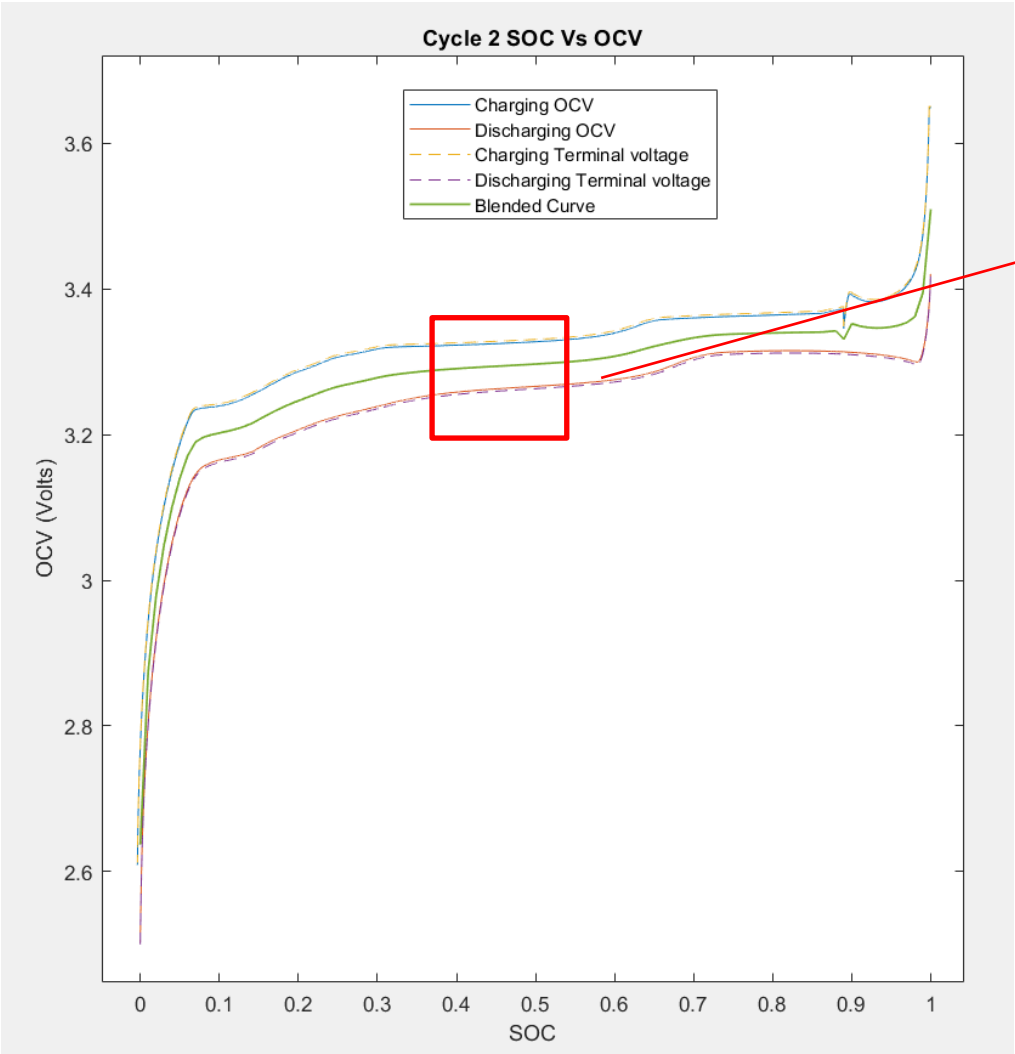
Comments: OCV is calculated by adding impedance factor and blending the charge-discharge graphs of 0.1C rate for cycle 2

Final Result of OCV vs SOC plot
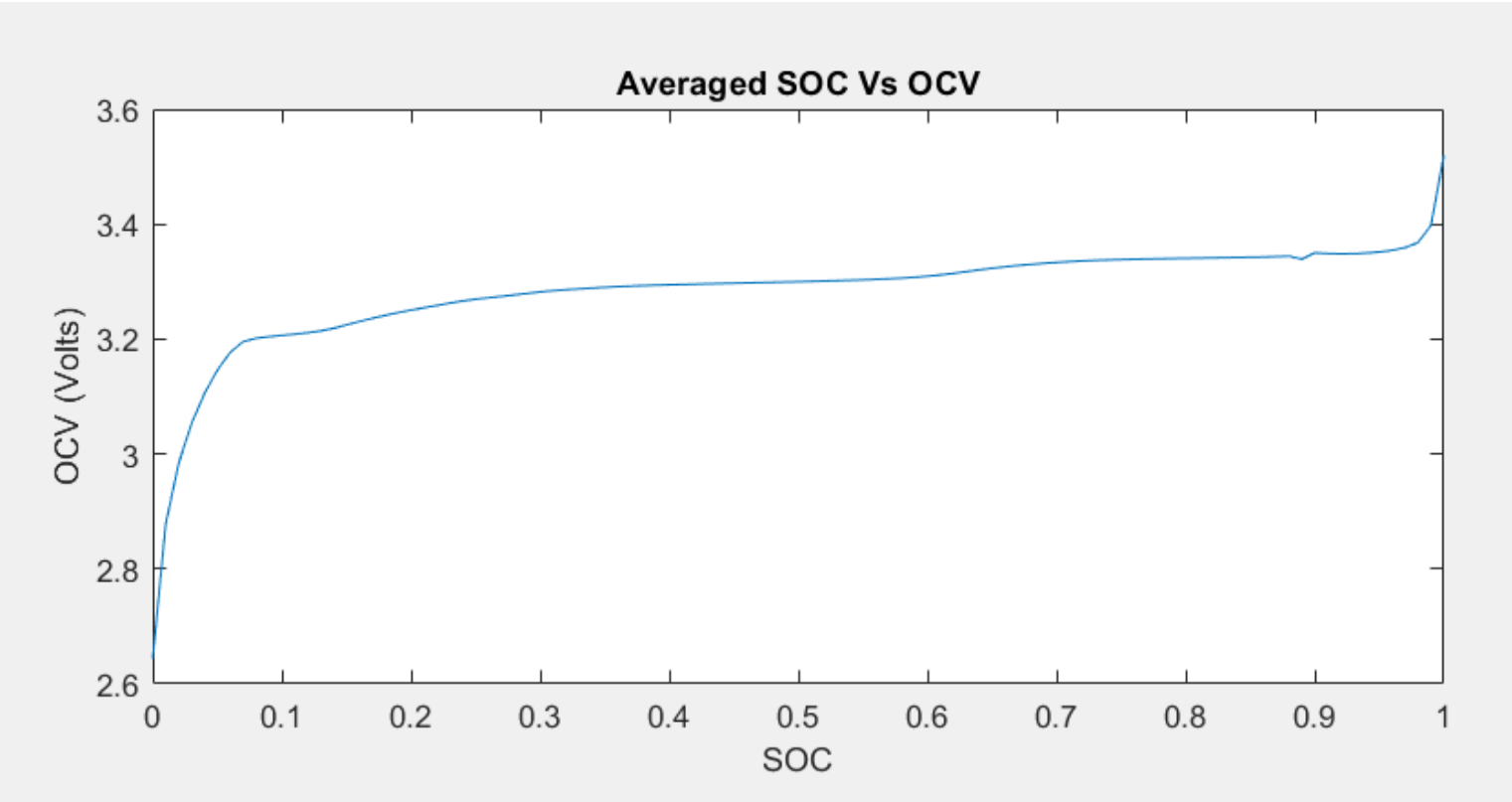
Comments: The two cycles have been averaged and the final OCV vs SOC plot is obtained. This plot will be used for configuration of BMS parameters

Comparison with Highstar Data- Discharging
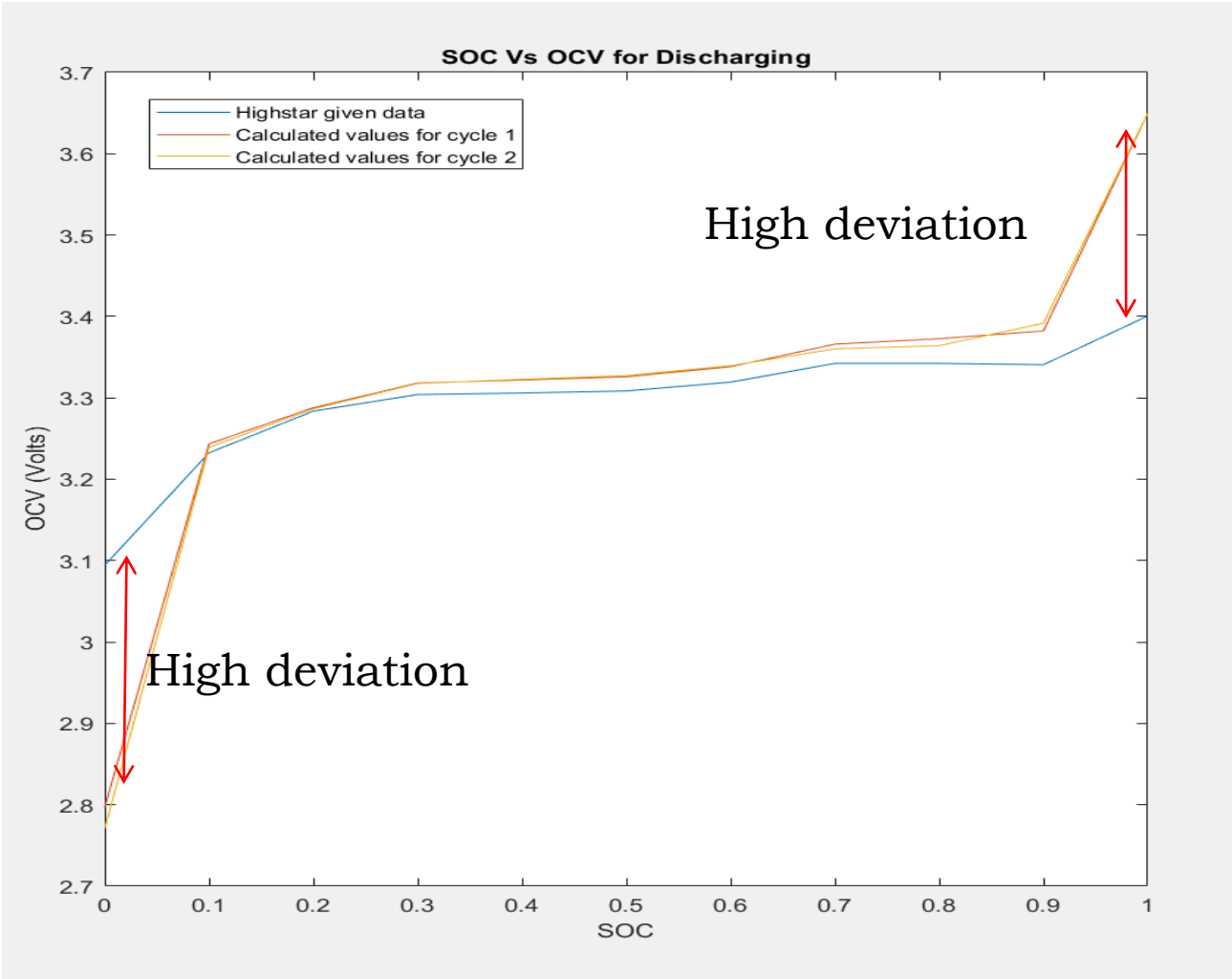
Dis.SOC	25℃ Given Data	25℃ Cycle 1 Calculated	25℃ Cycle 2 Calculated
100%	3.4412	3.41250	3.36930
90%	3.3293	3.31360	3.31290
80%	3.3289	3.31040	3.31500
70%	3.3271	3.30176	3.30560
60%	3.3004	3.28430	3.27540
50%	3.2905	3.27940	3.26620
40%	3.2880	3.27480	3.25821
30%	3.2837	3.25340	3.23870
20%	3.2567	3.22070	3.20650
10%	3.2139	3.17770	3.16500
0%	3.1023	2.50310	2.50310

Comments: The OCV vs SOC plot obtained from the above test is compared with the OCV vs SOC plot provided by Highstar. There is a significant deviation at lower and higher SOC between the two graphs. The reason for this is the Highstar graphs are obtained at 1C rate, which is not accurate metric for measuring OCV vs SOC.

Comparison with Highstar Data-Charging
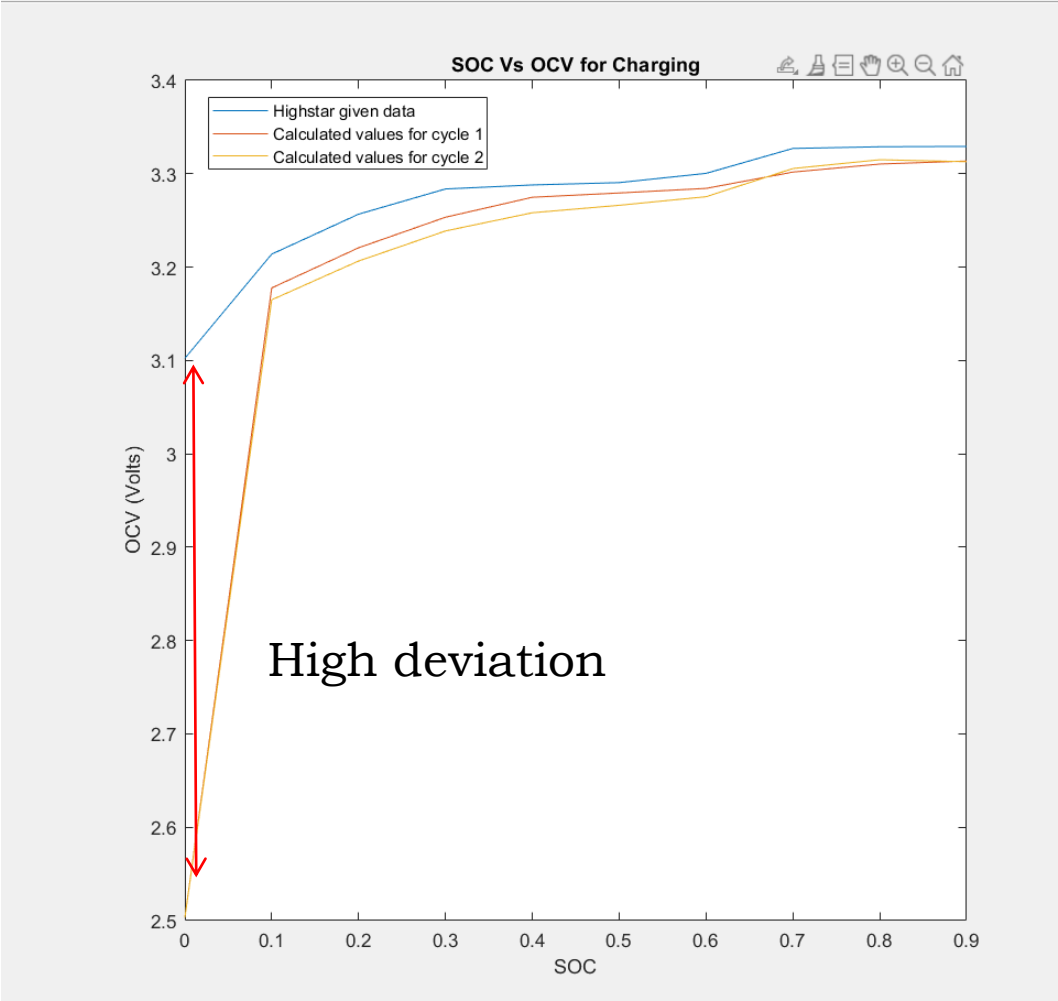
Dis.SOC	25℃ Given Datasheet	25℃ Cycle 1 Calculated	25℃ Cycle 2 Calculated
0%	3.0943	2.79693	2.77083
10%	3.2325	3.24350	3.23930
20%	3.2837	3.28790	3.28640
30%	3.3041	3.31820	3.31760
40%	3.306	3.32190	3.32280
50%	3.3085	3.32590	3.32740
60%	3.3193	3.33820	3.33950
70%	3.3423	3.36599	3.36020
80%	3.3423	3.37270	3.36410
90%	3.3407	3.38220	3.39178
100%	3.4006	3.64960	3.64960

Comments: The OCV vs SOC plot obtained from the above test is compared with the OCV vs SOC plot provided by Highstar. There is a significant deviation at lower between the two graphs. The reason for this is the Highstar graphs are obtained at 1C rate, which is not accurate metric for measuring OCV vs SOC.
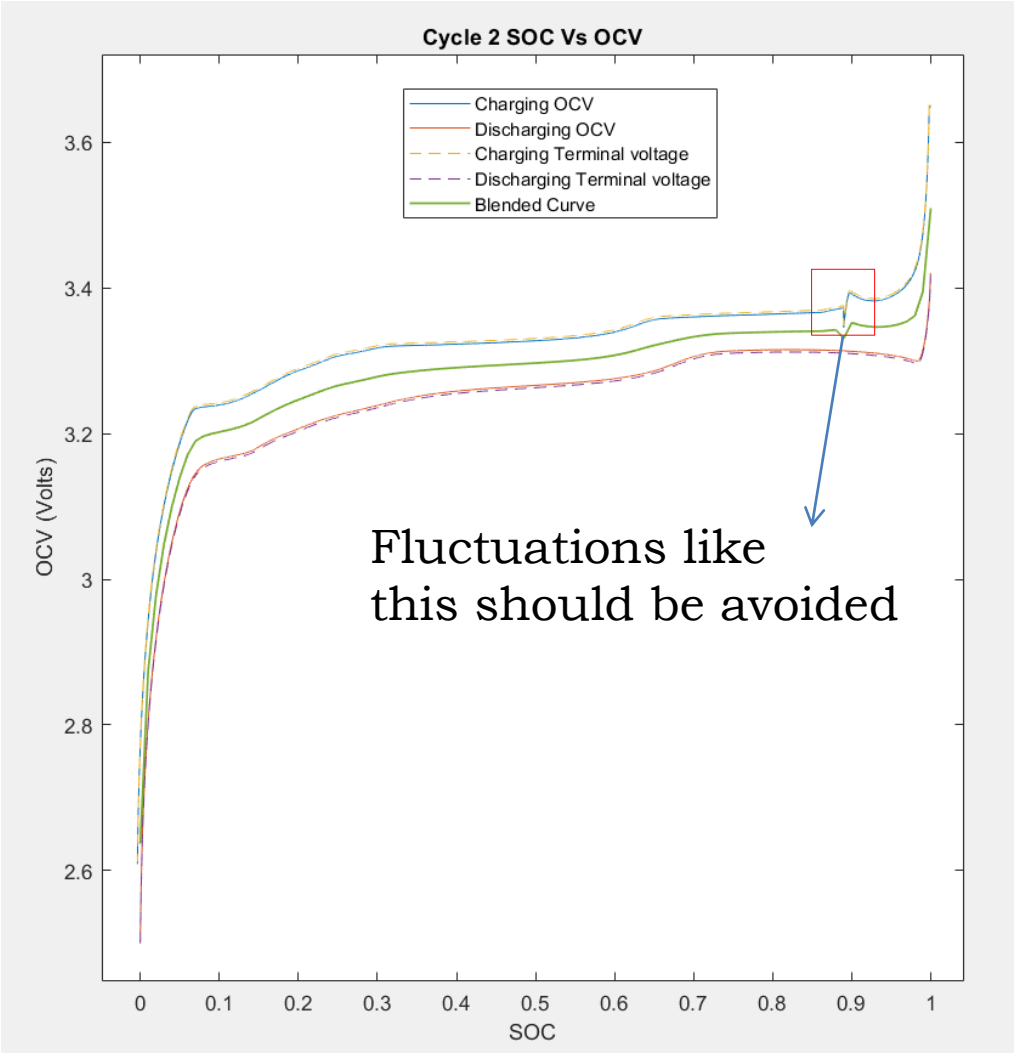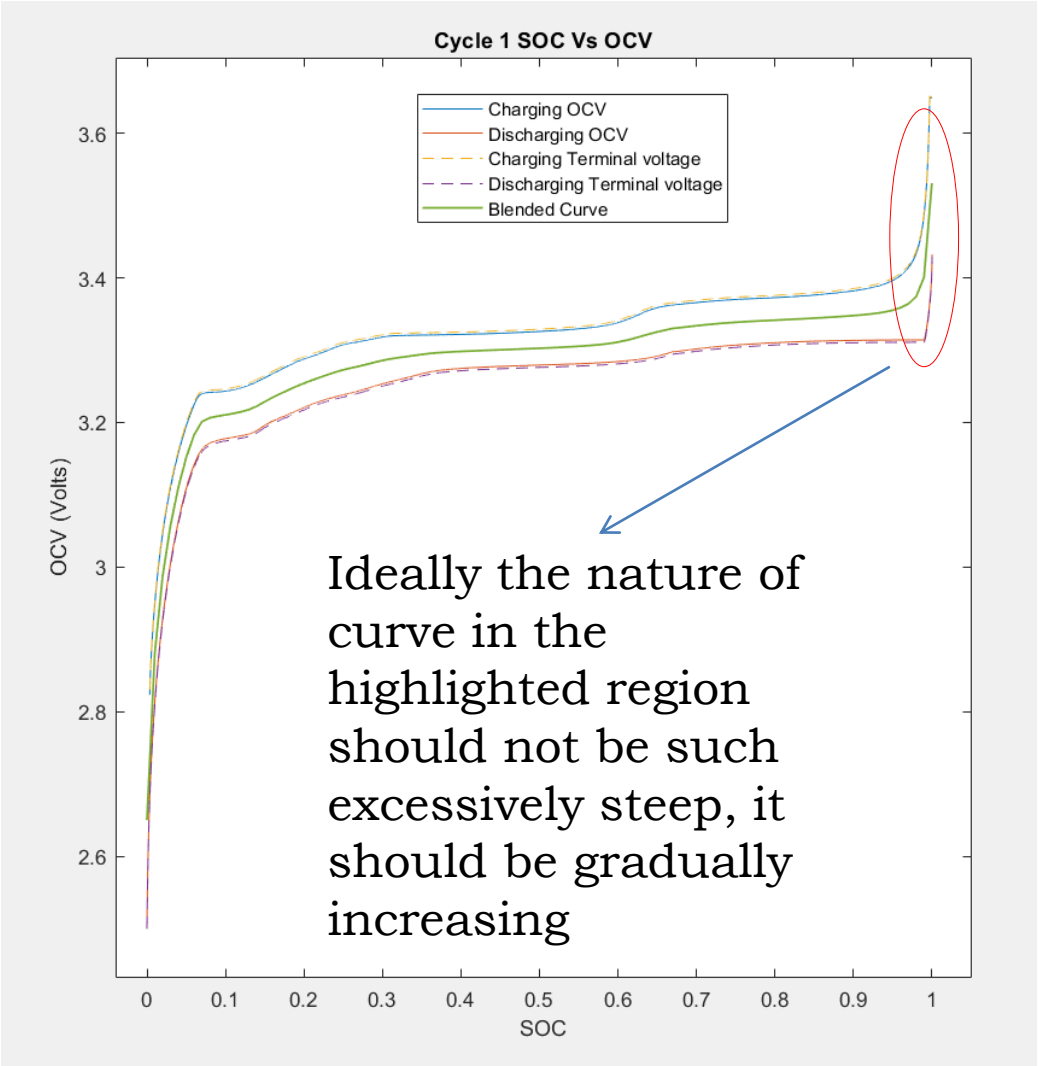
Interpolation of Cutoff values

Depth of Discharge%	Depth of Discharge (Min)%	Cutoff Open Circuit Voltage (V)	Depth of Discharge (Max)	Cutoff Open Circuit Voltage
100	0	2.64348893	100	3.520249427
90	5	3.104995136	95	3.34975
85	5	3.104995136	90	3.338941752
	10	3.204200008	95	3.34975
	5	3.104995136	85	3.342050002
	10	3.204200008	90	3.338941752
80	15	3.218700008	95	3.34975

Comments: The lower cutoff values are reasonable and can be configured into the BMS. The generally used DOD cutoff and the corresponding OCVs are highlighted above
For upper DOD cutoff the cutoff values are very close to the nominal voltage owing to the steep nature of the OCV vs SOC curve at high SOC region

Suggestions

Cycle 1 SOC Vs OCV

Charging OCV
Discharging OCV
Charging Terminal voltage
Discharging Terminal voltage
Blended Curve

Ideally the nature of curve in the highlighted region should not be such excessively steep, it should be gradually increasing

Cycle 2 SOC Vs OCV

Charging OCV
Discharging OCV
Charging Terminal voltage
Discharging Terminal voltage
Blended Curve

Fluctuations like this should be avoided

The End