Battery SOC indication FO1200

Because the FOC100 has no communication with the battery’s BMS, the SOC (State of Charge [%]) has to be estimated by comparing the measured voltage to the discharge curve of the battery.

For each supported battery the relation between SOC and voltage has to be known. There are two common ways to implement this relation:

1. By lookup table
2. Equation

The choice was made to use an equation because the use of a table would require too much memory, which is limited in the current hardware. A large number of table values are needed to be able to interpolate with enough accuracy.

The relation between SOC and voltage is exponential and has decimal values this means it requires floating point values for the calculation, which increases computation time a lot compared to the use of a lookup table.

uint16\_t battImpedance;

**float** socPolynoom[] = {0,0,0};

**switch**(dParameters.BattChem)

{

**case** 0:

battImpedance = 17; //Devide by 100

socPolynoom[0] = 0.65;

socPolynoom[1] = 49;

socPolynoom[2] = 922;

**break**;

uint16\_t BattVoltage = (uint16\_t)(\_IQtoF(gMotorVars.VdcBus\_kV)\*10000);

BattVoltage \*= 10;

BattVoltage += (dDisplayRealTimeData.BatteryCurrent\_A \* battImpedance); //Compensate voltage with 10% of current,

BattVoltage /= 100;

**void** **calcSoc**(**void**)

{

**int** battVolt = dProgramVars.batteryVoltage;//BusVoltageFiltered;///dParameters.BattCells;

**int** soc = (socPolynoom[0] \* battVolt \* battVolt) - (socPolynoom[1]\*battVolt) + socPolynoom[2];

**if**(soc > 100)

soc = 100;

**if**(soc < 1)

soc = 1;

dDisplayRealTimeData.BatteryLevel = (uint16\_t)soc;

}

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Batterijcurves benadering | | |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  | Phylion 14 Ah | |  | Phylion 8,7 Ah | |
| Impedantie [mOhm] | | 126 |  |  |  |  |
|  | 0 Amp | 7 Amp | % |  | 0 amp |  |
| 52 | 52,882 | 0,3 | 97,54098 |  |  |  |
| 51 | 51,882 | 2 | 83,60656 |  | 0 | 100 |
| 50 | 50,882 | 3,1 | 74,59016 |  | 0,2 | 97,31544 |
| 49 | 49,882 | 4,4 | 63,93443 |  | 1,5 | 79,86577 |
| 48 | 48,882 | 5,4 | 55,7377 |  | 2,45 | 67,11409 |
| 47 | 47,882 | 6,5 | 46,72131 |  | 3,43 | 53,95973 |
| 46 | 46,882 | 7,7 | 36,88525 |  | 4,3 | 42,28188 |
| 45 | 45,882 | 8,8 | 27,86885 |  | 5,43 | 27,11409 |
| 44 | 44,882 | 10 | 18,03279 |  | 6,1 | 18,12081 |
| 43 | 43,882 | 10,8 | 11,47541 |  | 6,75 | 9,395973 |
| 42 | 42,882 | 11,4 | 6,557377 |  | 7,15 | 4,026846 |
| 41 | 41,882 | 11,7 | 4,098361 |  | 7,25 | 2,684564 |
| 40 | 40,882 | 11,9 | 2,459016 |  | 7,35 | 1,342282 |
| 39 | 39,882 | 12,2 | 0 |  | 7,45 | 0 |
|  |  |  |  |  |  |  |
| Impedantie [mOhm] | | 126 |  |  | 169 |  |

Test

Override voltage and current with debug parameters to test if the SOC is calculated correct.

Test 1

Conclusion

Decimal values from battery voltage are lost somewhere in the calculation. See test 2 below for update.

Test 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Phylion 14 Ah | |  |  |  | Test 1 |  |
|  | Current |  |  |  |  |  |
| Voltage | 0 | 5 | 10 | 15 | 20 | 25 |
| 55 | 100 | 100 | 100 | 100 | 100 | 100 |
| 54 | 100 | 100 | 100 | 100 | 100 | 100 |
| 53 | 99 | 99 | 100 | 100 | 100 | 100 |
| 52 | 87 | 87 | 99 | 99 | 100 | 100 |
| 51 | 75 | 75 | 87 | 87 | 99 | 100 |
| 50 | 64 | 64 | 75 | 75 | 87 | 99 |
| 49 | 54 | 54 | 64 | 64 | 75 | 87 |
| 48 | 44 | 44 | 54 | 54 | 64 | 75 |
| 47 | 36 | 36 | 44 | 44 | 54 | 64 |
| 46 | 28 | 28 | 36 | 36 | 44 | 54 |
| 45 | 21 | 21 | 28 | 28 | 36 | 44 |
| 44 | 15 | 15 | 21 | 21 | 28 | 36 |
| 43 | 9 | 9 | 15 | 15 | 21 | 28 |
| 42 | 5 | 5 | 9 | 9 | 15 | 21 |
| 41 | 1 | 1 | 5 | 5 | 9 | 15 |
| 40 | 1 | 1 | 1 | 1 | 5 | 9 |
| 39 | 1 | 1 | 1 | 1 | 1 | 5 |
| 38 | 1 | 1 | 1 | 1 | 1 | 1 |
| 37 | 1 | 1 | 1 | 1 | 1 | 1 |
| 36 | 1 | 1 | 1 | 1 | 1 | 1 |
| 35 | 1 | 1 | 1 | 1 | 1 | 1 |
| 34 | 1 | 1 | 1 | 1 | 1 | 1 |
| 33 | 1 | 1 | 1 | 1 | 1 | 1 |
| 32 | 2 | 2 | 1 | 1 | 1 | 1 |
| 31 | 6 | 6 | 2 | 2 | 1 | 1 |
| 30 | 11 | 11 | 6 | 6 | 2 | 1 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Phylion 14 Ah | |  |  |  |  | Test 2 |
|  | Current |  |  |  |  |  |
| Voltage | 0 | 5 | 10 | 15 | 20 | 25 |
| 55 | 100 | 100 | 100 | 100 | 100 | 100 |
| 54 | 100 | 100 | 100 | 100 | 100 | 100 |
| 53 | 99 | 100 | 100 | 100 | 100 | 100 |
| 52 | 87 | 94 | 100 | 100 | 100 | 100 |
| 51 | 75 | 82 | 89 | 97 | 100 | 100 |
| 50 | 64 | 70 | 77 | 84 | 92 | 99 |
| 49 | 54 | 60 | 66 | 73 | 80 | 87 |
| 48 | 44 | 50 | 56 | 62 | 68 | 75 |
| 47 | 36 | 41 | 46 | 52 | 58 | 64 |
| 46 | 28 | 33 | 37 | 43 | 48 | 54 |
| 45 | 21 | 25 | 29 | 34 | 39 | 44 |
| 44 | 15 | 18 | 22 | 26 | 31 | 36 |
| 43 | 9 | 12 | 16 | 20 | 24 | 28 |
| 42 | 5 | 7 | 10 | 14 | 17 | 21 |
| 41 | 1 | 3 | 6 | 8 | 11 | 15 |
| 40 | 1 | 1 | 2 | 4 | 6 | 9 |
| 39 | 1 | 1 | 1 | 1 | 2 | 5 |
| 38 | 1 | 1 | 1 | 1 | 1 | 1 |
| 37 | 1 | 1 | 1 | 1 | 1 | 1 |
| 36 | 1 | 1 | 1 | 1 | 1 | 1 |