Panasonic UR18650ZTA 3.7 V Li-ion cylindrical cell

Cell type & chemistry

- Lithium-ion (NMC-based)
- Cylindrical 18650 (Ø 18.24 × 65.10 mm max)
- **Weight–** Max. 49.0 g
- **Cycle life–** ~500 full CC–CV cycles before capacity falls below ~80 % (under normal use)
- **Version & notes–** Datasheet version: 13.05 R2 (2012)

```
BATT = struct( ...
    'Manufacturer', 'Panasonic'   , ...
    'Chemistry'   , 'Lithium Ion', ...
    'Model'       , 'UR18650ZTA' , ...
    'Diameter'    , 18.24        , ...  % in mm (typical 18650 size)
    'Length'      , 65.10        , ...  % in mm (typical 18650 size)
    'CycleLife'   , 500            ...
);

BATT.Package = struct( ...
    'Ns_Module'  , 1, ...
    'NumModules' , 3 ...
);
```

Capacity

- Typical: 3000 mAh
- Minimum: 2900 mAh @ 0.2 C discharge to 2.75 V (25 °C)

```
BATT.Capacity = struct( ...             % in Ah
    'Rate', 2.850, ...
    'Min' , 2.900, ...
    'Type', 3.000  ...
);
```

Voltage

- Nominal: 3.7 V
- Charge cut-off: 4.35 ± 0.05 V
- Discharge cut-off: 2.50 V
- **Storage conditions –**20 °C to +50 °C (long-term)

```
BATT.Voltage = struct( ...              % in Volts
    'Nominal'    , 3.70, ...
```

```
    'Cut_off'     , 3.00, ...
    'Full_Dchrg' , 4.20, ...
    'Max_Chrg'    , 4.35  ...
);

BATT.Temperature = struct( ...                % in °C
    'Max'  , +50, ...
    'Min'  , -20, ...
    'Temps', [-20, -10, 0, 20, 40] ...
);
```

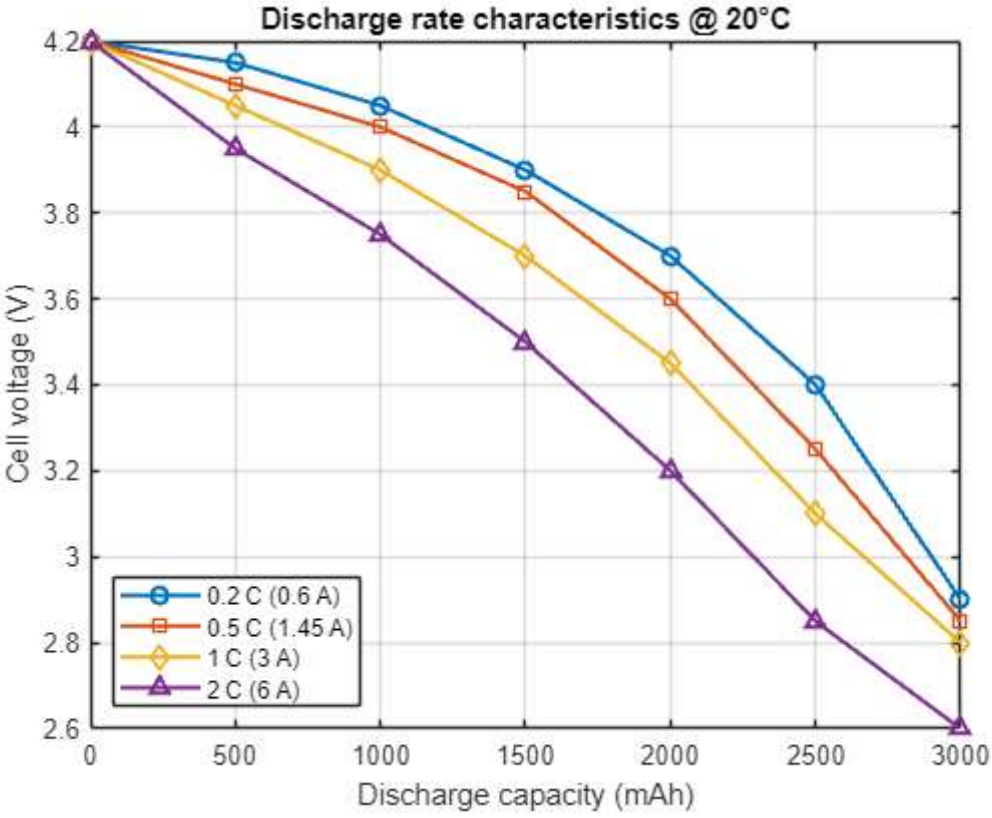
Charge characteristics

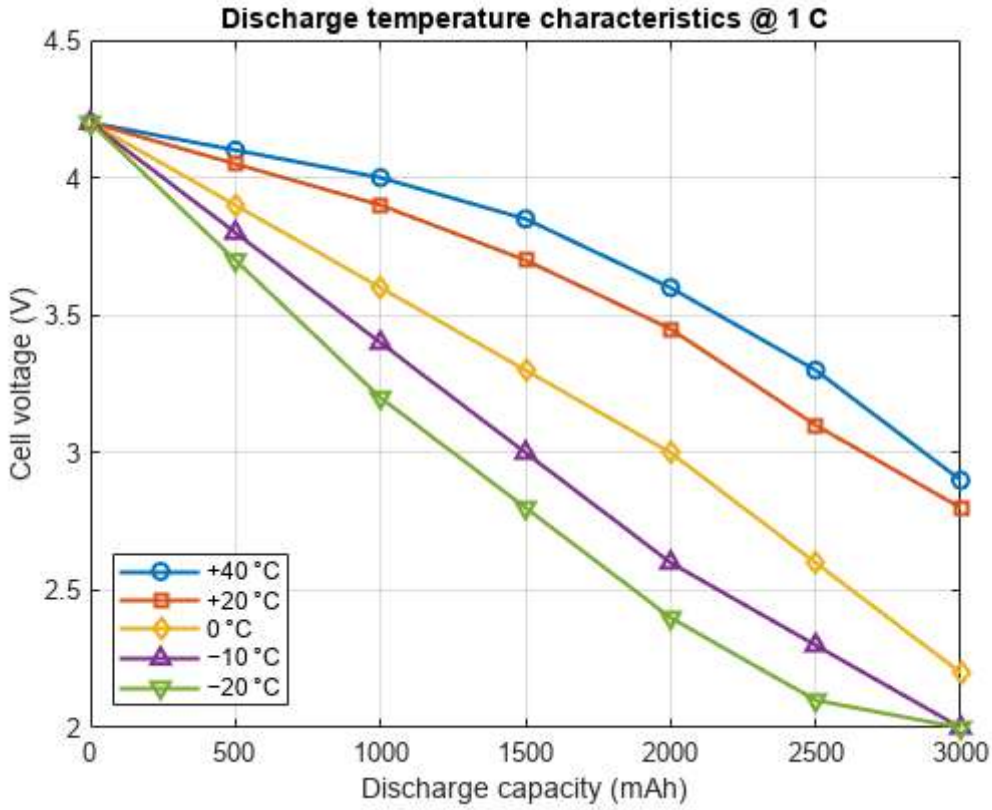
- Method: CC–CV (constant-current, constant-voltage)
- Standard current: 0.5 C (max) / 1450 mA
- Standard charge time: ~4 h (to 4.35 V, 58 mA cut-off)
- Temperature range: 0 °C to +45 °C

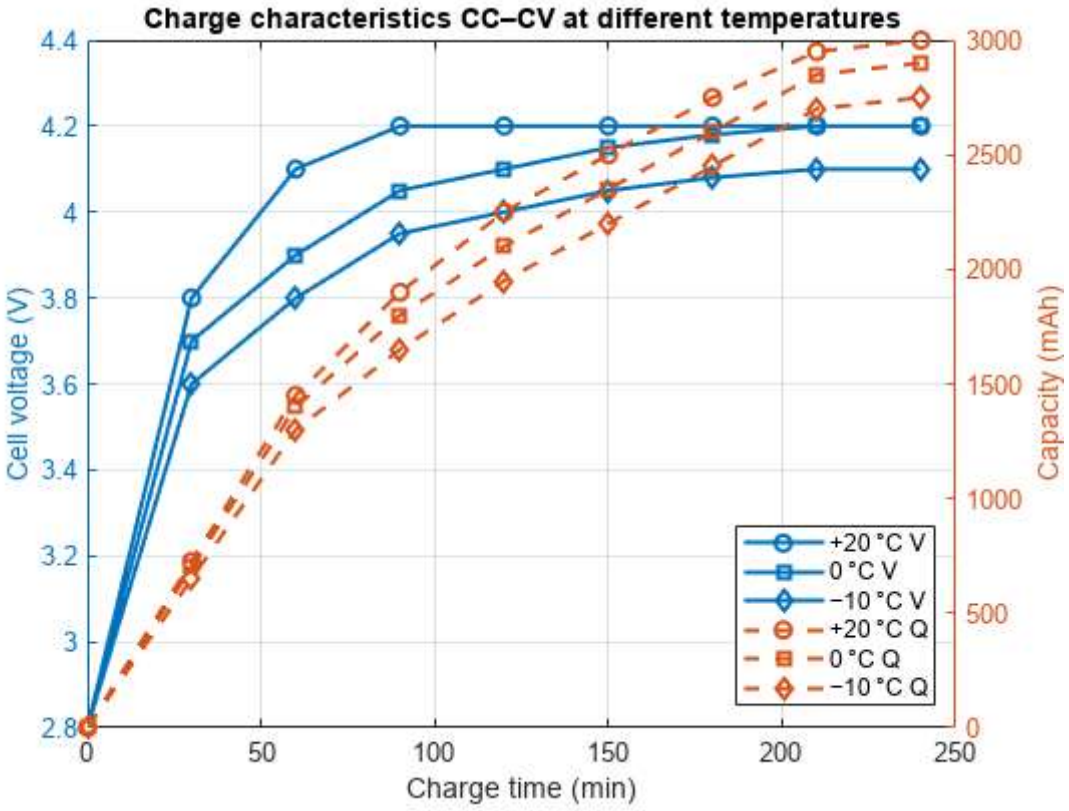
Discharge characteristics

- Method: CC 1 C (typical)
- Temperature range: –20 °C to +60 °C
- Rate performance: see curves

```
Battery_Curves
```


Discharge rate characteristics @ 20°C
Cell voltage (V)
Discharge capacity (mAh)
0.2 C (0.6 A)
0.5 C (1.45 A)
1 C (3 A)
2 C (6 A)
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
0
500
1000
1500
2000
2500
3000


Discharge temperature characteristics @ 1 C
Cell voltage (V)
Discharge capacity (mAh)
+40 °C
+20 °C
0 °C
−10 °C
−20 °C
4.5
4
3.5
3
2.5
2
0
500
1000
1500
2000
2500
3000




```
BATT.Current = struct( ...                  % in Amps
    'Dchrg'    ,  6.000, ...                % (2.0C)standard discharge current
    'Chrg'     ,  1.450, ...                % (0.5C)standard charge current
    'Chrgfast',  2.500  ...                 % fast charge current
);

BATT.Temperature.T_LUT       = [ -20,  -10,    0,   20,   40];   % °C
BATT.Temperature.derate_Fact = [0.60, 0.77, 0.87, 1.00, 1.03];
```

Current Limit Calculation

1. Discharge-current limit

Concept:

- At 20 °C the maximum continuous discharge current is **6 A (2 C)**.
- As temperature T moves away from 20 °C, we apply a derating factor d(T) (**taken from the 1 C capacity vs. T curve**).
- Within a single discharge, current capability also falls linearly as cell voltage V drops from the full-voltage $\mathbf{Vfull} = 4.2\mathbf{V}$down to the cut-off .$\mathbf{Vcut} = 3.0\mathbf{V}$

Putting that together, the instantaneous allowed discharge current Limit is:

$$I_{\text{LimDis}}(T,V) = \left(I_{\text{Dchrg}} \cdot \mathbf{d}(T) \cdot \frac{V - V_{\text{Cut\_off}}}{V_{\text{Full\_Dchrg}} - V_{\text{Cut\_off}}} \right)$$

2. Charge-current limit

Concept:

- At 20 °C the maximum continuous Charge current is **1.45 A (0.5 C)**.
- We only allow charging when $\mathbf{T} \geq 0°\mathbf{C}$ (below that $\mathbf{I}_{\mathrm{LimChg}} = 0$).
- During constant-current charge the allowable current tapers linearly from full at $\mathbf{Vcut} = 3.0\mathbf{V}$ to zero at the CV-cutoff $\mathbf{Vmax} = 4.35\mathbf{V}$

Thus the charge limit is:

$$\boldsymbol{I}_{\mathrm{LimChg}\,(T,V)} = \left(\boldsymbol{I}_{\mathrm{Chrg}} \cdot (T \geq 0) \cdot \frac{\boldsymbol{V}_{\mathrm{Max\_Chrg}} - V}{\boldsymbol{V}_{\mathrm{Max\_Chrg}} - \boldsymbol{V}_{\mathrm{Cut\_off}}} \right)$$