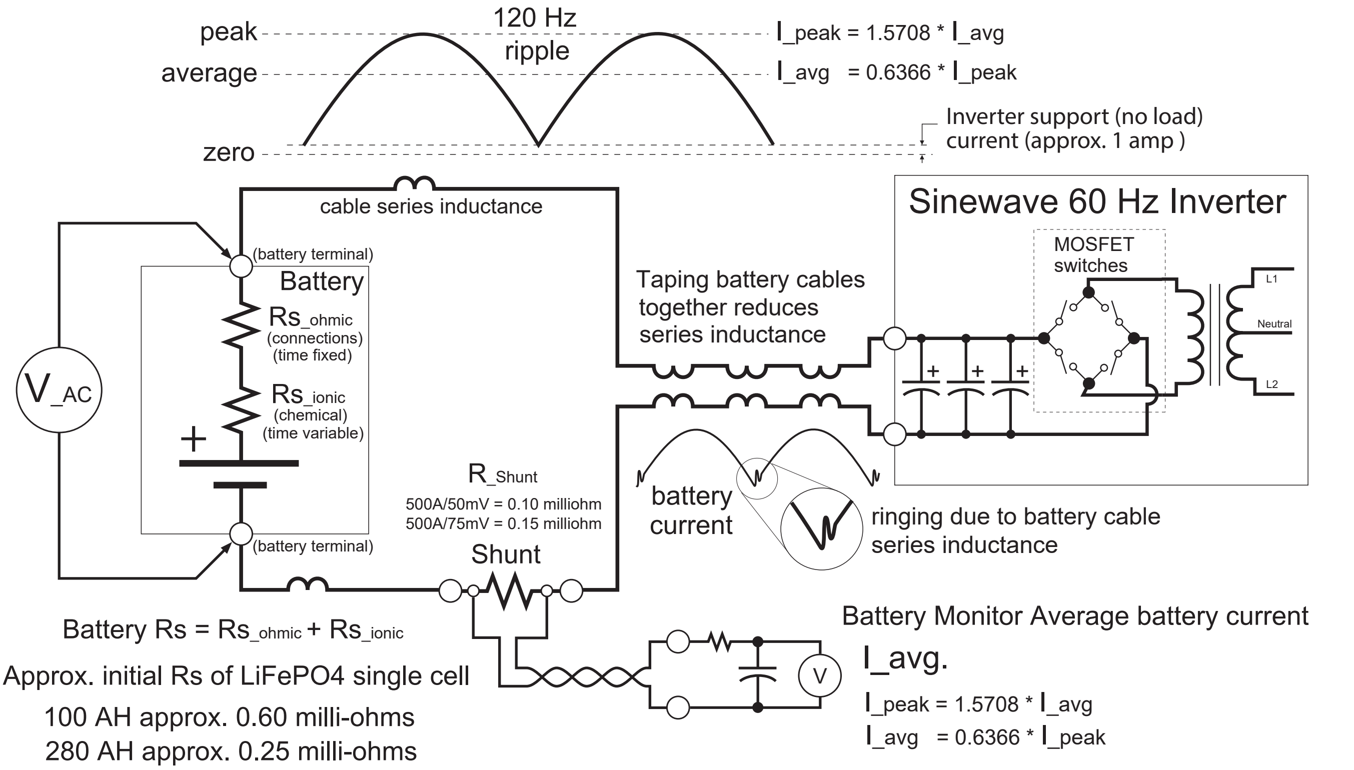
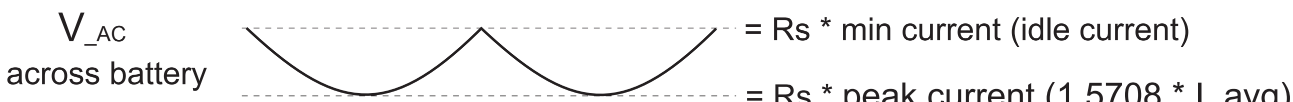
DC current profile

on battery

Battery peak current = 1.5708 x average current

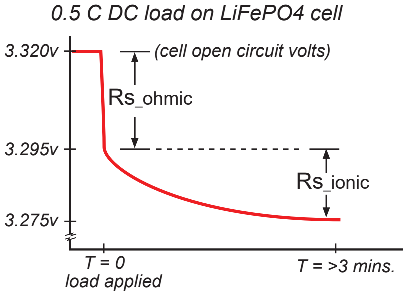



Battery Rs = Rs_ohmic + Rs_ionic.

Rs_ohmic is material contact resistance and terminal resistance. Rs_ionic is chemical ion movement resistance.
Rs_ionic is caused by localized depletion of available ions that have to replaced with a transition movement delay.
This results in exponential decay increasing apparent Rs, similar to long time contant RC discharge.
Rs_ionic looks like a resistance but it is actually chemical energy kinetics voltage drop required to transport ions.
The greater the discharge current, the more kinetic voltage drop required to transport the needed quantity of ions.
Eventually the Rs_ionic resistance will nearly level out when equilibrium is reached at a given discharge current.
Rs_ionic resistance is good indicator of battery quality. Battery impedance meters measure primarily Rs_ohmic
Rs appearent of LiFePO4 single cell nearly doubles after 3 to 5 mins. of 0.5C discharge due to R_ionic increase.
Rs_ionic resistance will recover to low current level within 5-15 minutes of load being removed.
Measuring Rs_ionic requires rapid current load pulsing as no load voltage will drop due to ion transport kinetic voltage drop.

*0.5 C DC load on LiFePO4 cell*




$V_{AC\ pk\text{-}pk} = Rs * (I_{pk\text{-}pk})$, $I_{pk\text{-}pk} = 1.5708 * (I_{avg} - I_{idle})$, *assuming sinewave inverter*

$V_{AC\ pk\text{-}pk} = Rs * (1.5708 * I_{avg} - I_{idle})$

$Rs = V_{AC\ pk\text{-}pk} / (1.5708 * (I_{avg} - I_{idle}))$, $V_{AC\ pk\text{-}pk} = V_{rms} / 0.70711$

$Rs = (V_{rms} / 0.70711) / (1.5708 * (I_{avg} - I_{idle}))$

***need true RMS AC coupled DVM to measure waveform***

*there will be an initial spike in DVM reading to charge its coupling cap.*

Knowing the average DC current and AC voltage across battery
the Rs of battery can be determined. (assumes sinewave inverter)

## Example for 280 AH LiFePO4 cell with 50 - 100 amp load

- Prepare an inverter AC load that will draw 50-100 amps average DC battery current.
- Twist DVM leads to reduce stray pickup, keep leads at right angle to battery cables to reduce coupling.
- Connect AC true rms DVM to battery terminals directly (not battery cables on terminals).
- Measure inverter avg I_DC idle current from Batt Monitor, apply inverter load, measure I_DC and AC voltage after settles.

Measurements: $V_{rms}$ = 27.8 mVrms, $I_{idle}$ = 0.7 amps, $I_{avg}$ with load = 97.2 amps

$Rs = (V_{rms} / 0.70711) / (1.5708 * (I_{avg} - I_{idle}))$, $Rs = (27.8\ mVrms / 0.70711) / (1.5708 * (97.2A - 0.7A))$

**$Rs$ = 0.259 milli-ohms**