# Multiphase Buck Game Plan

## Problems/Changes

* IC power dissipation is too high
  + Can relieve this by either going down to 1 FET and a slightly lower frequency
  + Or by using a FET with a lower QGate
* Thermal reliefs on small passives are too thick
* Add in a way to break open each channel to measure output current
* Currently IC power losses may be making up the majority of power losses on the board.
* New FET – should only need one, place footprints for two

## Testing

* Still need to test full load regulation
* Should test ripple across full range of loads
* Should test transient with larger change in load
* Overcurrent and overvoltage protection

## Current Performance

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Target** | **Current** | **Causes/Changes** |
| Line Regulation | <0.1% | <0.04% | None |
| Load Regulation |  | <0.3% |  |
| Output Ripple | 25mV | 304mV |  |
| Transient Response |  | 0.625V;425us |  |

## Improvements

* Load Regulation: reduce resistance of high power traces – make em fat
* Ripple Voltage (Double check data sheet calculations:
  + More output capacitance
  + Higher switching frequency
  + Reduce inductor impedance in high-frequency operation
  + Reduce output capacitor impedance in high frequency operation
    - NPo capacitor
  + Reduce the switching-node voltage spike.
    - Adding a bootstrap resistor in series or an RC snubber circuit
  + Use a high capacity polarised filter capacitor parallel to the power outputs.
  + The challenge here is to use a capacitor with a sufficiently high self-resonance frequency, possibly with higher ESR if current is low enough. If the output current is large, then go for a ferrite or inductor to induce more damping into the self-resonance.
  + Second stage output filter (LC filter) with low ESR output capacitors
    - Need to make sure sense lines are to the left of the LC filter so the sense lines are not disrupted by the filter
    - The corner frequency can’t be too low
    - Small inductance
  + Consider switching out electrolytics for ceramic (see data sheet)
  + **Low ESR ceramic capacitors are the easiest way to reduce output ripple**
    - ESR inhibits a capacitor’s ability to quickly sink or source charge
  + Including some small ceramic additionally may help as well
  + Common mode filter
  + Need to check what the electrolytic capacitors ESR is at the expected, temperature and frequency.
  + [Capacitance Multiplier](https://www.youtube.com/watch?v=wopmEyZKnYo&ab_channel=EEVblog) (RC filter with a series pass transistor) – probably only good for low power

## To-Do

1. Research which areas need improvement and outline steps which can be taken do improve them.