ABSTRACT
This memo outlines the design process for choosing a bypass resistor, including resistance value, power rating, case and mount style, and heatsink.

TECHNICAL FINDINGS
All initial calculations were made with a sample resistor and heatsink that were reasonable choices for the analysis. Because heat dissipation is easily our most limiting metric, we begin by determining the upper limit of both heat change and power dissipated, as well as the important physical parameters of the components. From the MATLAB script:

```matlab
% Temperature Design Curves for Bypass Resistor
% Initial assumptions using an LTO50 resistor and an HS-193 heatsink, TO-220
delT = 40 - 20; % in Celcius, 40 being the max. temp and 20 being ambient
RThr = 2.5; % Thermal resistance of the resistor
RThhss = 12.4; % Thermal resistance of the heatsink, still air
RThhsf = 4; % Thermal resistance of the heatsink, flowing air

This allows a calculation of a static power, which leads to a calculation of current based on a constant power dissipation and varying resistance, given by:

```matlab
Pstill = delT/(RThr + RThhss); % Power dissipation, no airflow
Pflow = delT/(RThr + RThhsf); % Power dissipation, airflow

R = 1:.01:50; % Sample range of electrical resistance values

Iflow = sqrt(Pflow./R); % Current values varying with R
Istill = sqrt(Pstill./R);
```

Finally, we can plot these curves to understand the relationship between current and resistance while power dissipated is constant. As a useful comparison, Ohm’s Law is included, calculated as $I=V/R$, using a constant 3 Volts over the range of $R$.

```matlab
% Plots no flow current in red, flow current in blue, 3V/R in green.
semilogx(R,Istill, 'r', R,Iflow, 'b1', R, 3./R, 'g');
```
RECOMMENDATIONS AND DECISIONS

After considering the tradeoffs associated with different resistor values, a consensus was made for the 2-4 Ω range, with the optimal being 2.2 Ω. This value leaves some room for thermal control through PWM control, as well as space for a better heatsink to be used. Also, this means even in the worst case scenario, the system should still not exceed 50 °C. Alternative heatsinks could be used to expand this range even further.