Parkhomov-Type Replication Using a Chopped DC Heater Source

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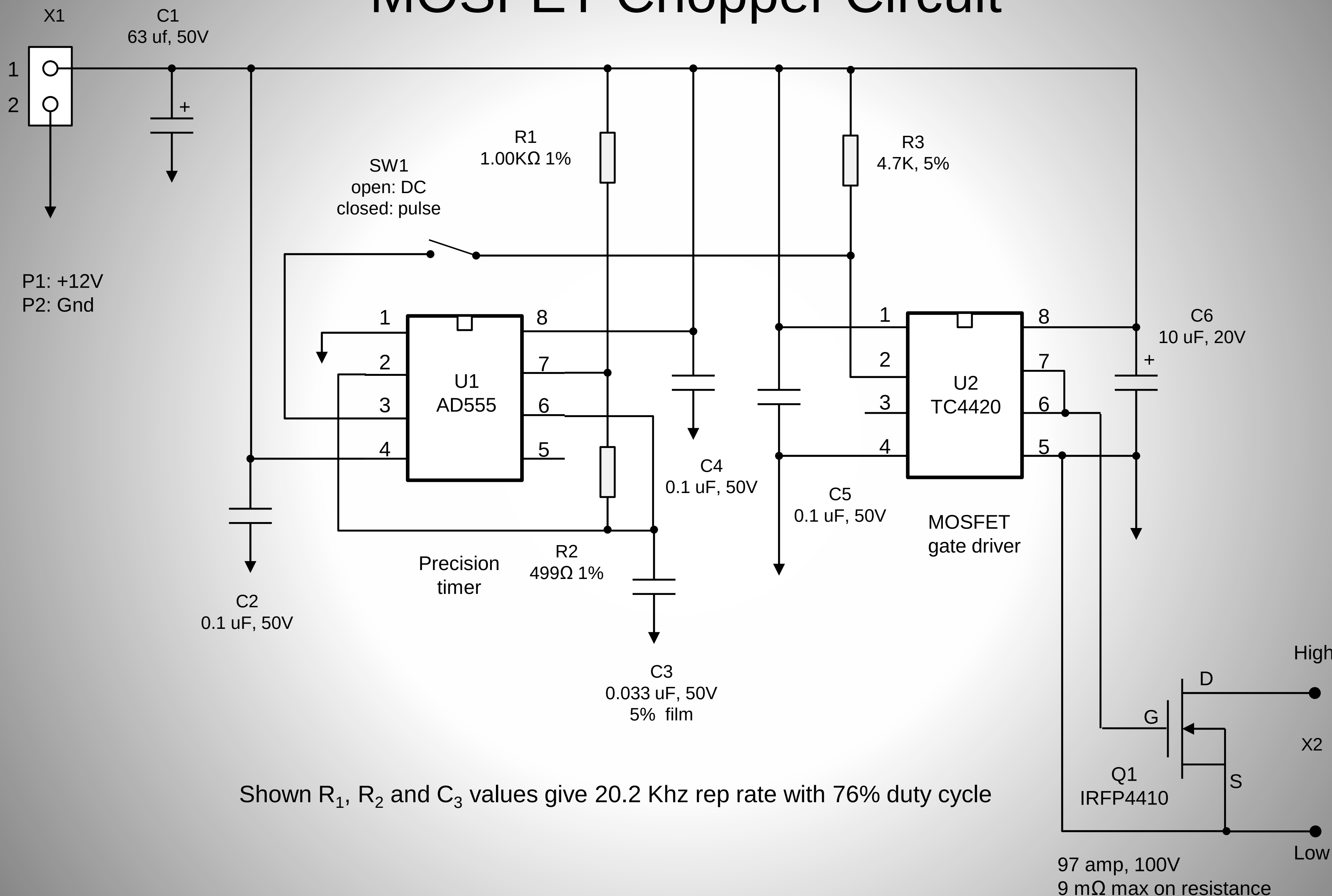
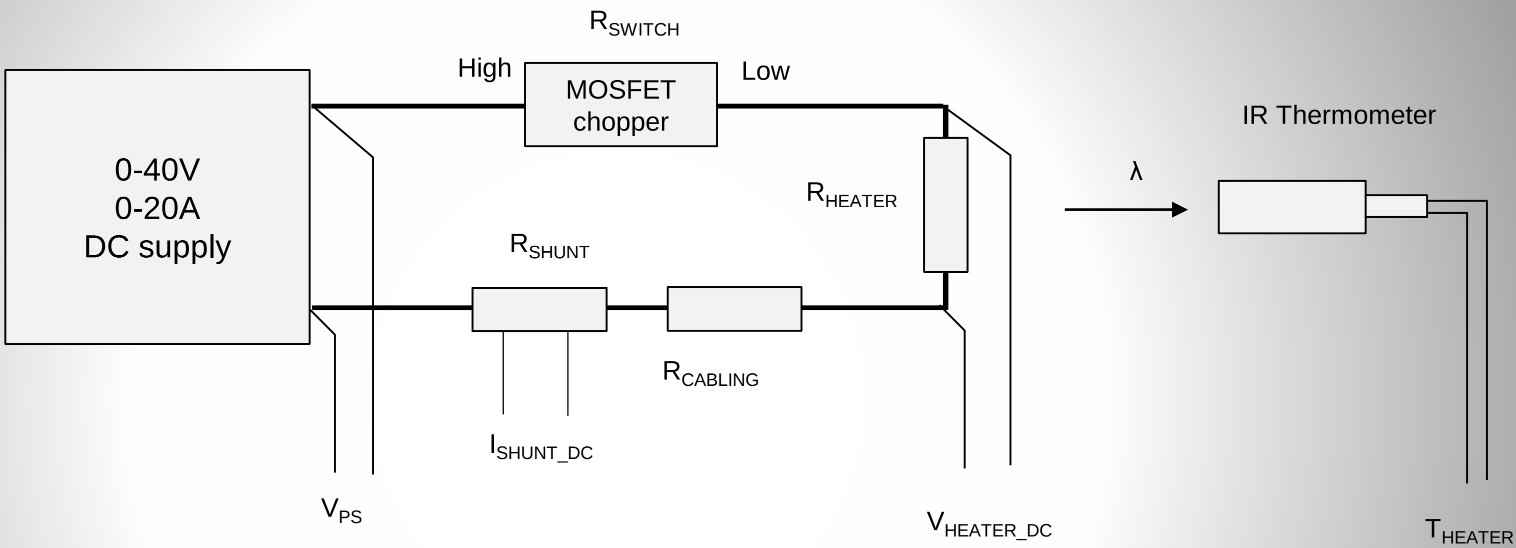
MOSFET Chopper Circuit



Shown R_1, R_2 and C_3 values give 20.2 Khz rep rate with 76% duty cycle

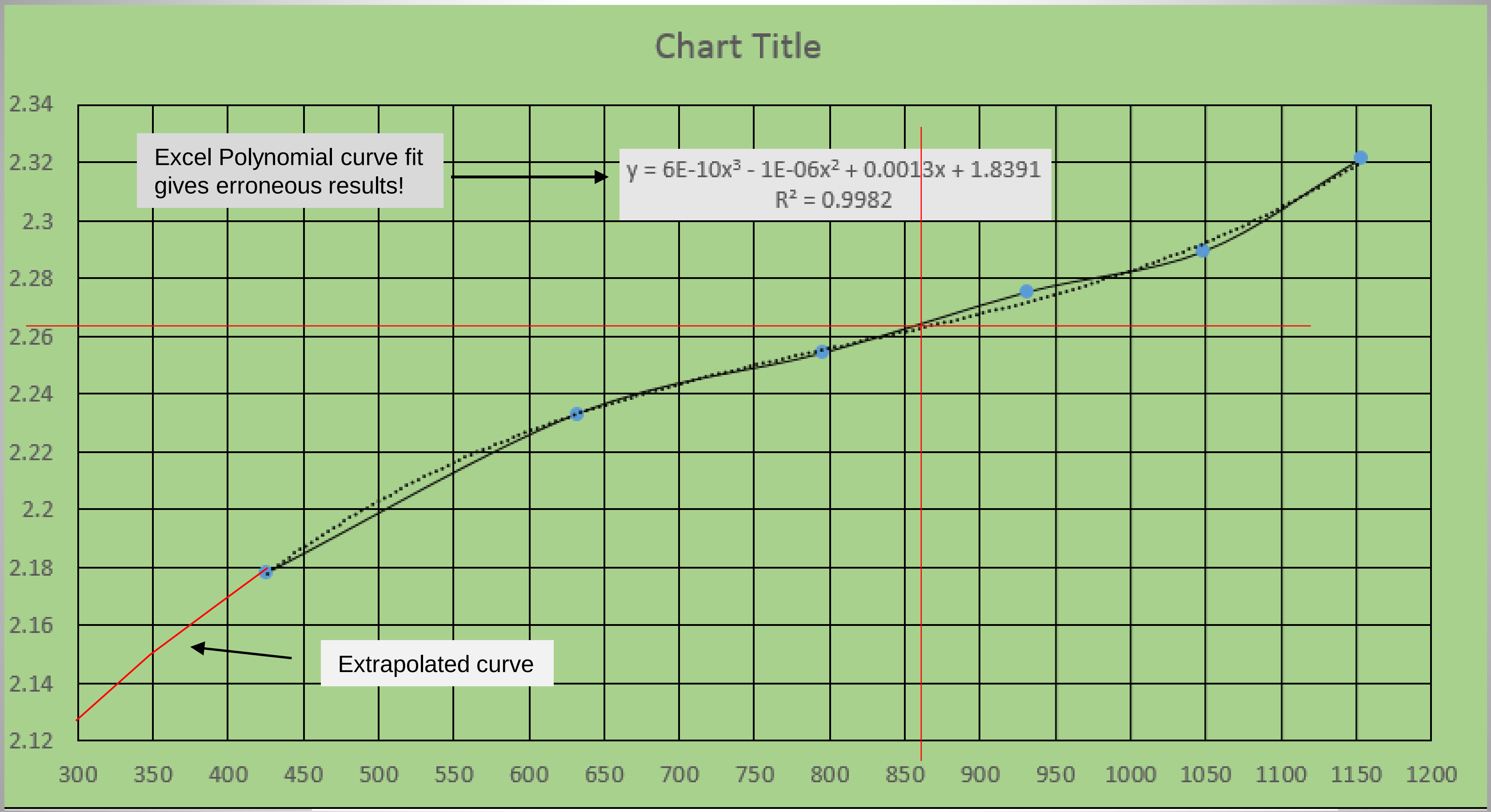
Calculating Chopped DC Power



1. Set DC P/S to 15V and SW1 to "DC" state
2. Measure $I_{SHUNT\text{-}DC}$, V_{PS}, and V_{HEATER_DC}, repeat for P/S set to 20V as a means of checking reproducibility or results.
3. The voltage difference between V_{PS}, and V_{HEATER_DC} divided by I_{SHUNT_DC} yields the cabling + shunt + MOSFET resistance
4. $R_{SHUNT} + R_{CABLING} + R_{SWITCH} = .03439\ \Omega$

5. With SW1 in the "DC" state set V_{PS} to 10, 15, … 35V
6. For each voltage reading record T_{HEATER}, $I_{SHUNT\text{-}DC}$, and V_{PS}
7. Compute and graph R_{HEATER} vs. T_{HEATER} this will give a curve that permits one to determine R_{HEATER} during pulsed operation based only on temperature. Neither pulsed voltage nor current are easily measured, however, the chopper duty cycle can be accurately measured with a digital scope
8. This analysis assumes that the heater can be treated as a resistive load (Heater L/R time constant is << "on" pulse width).

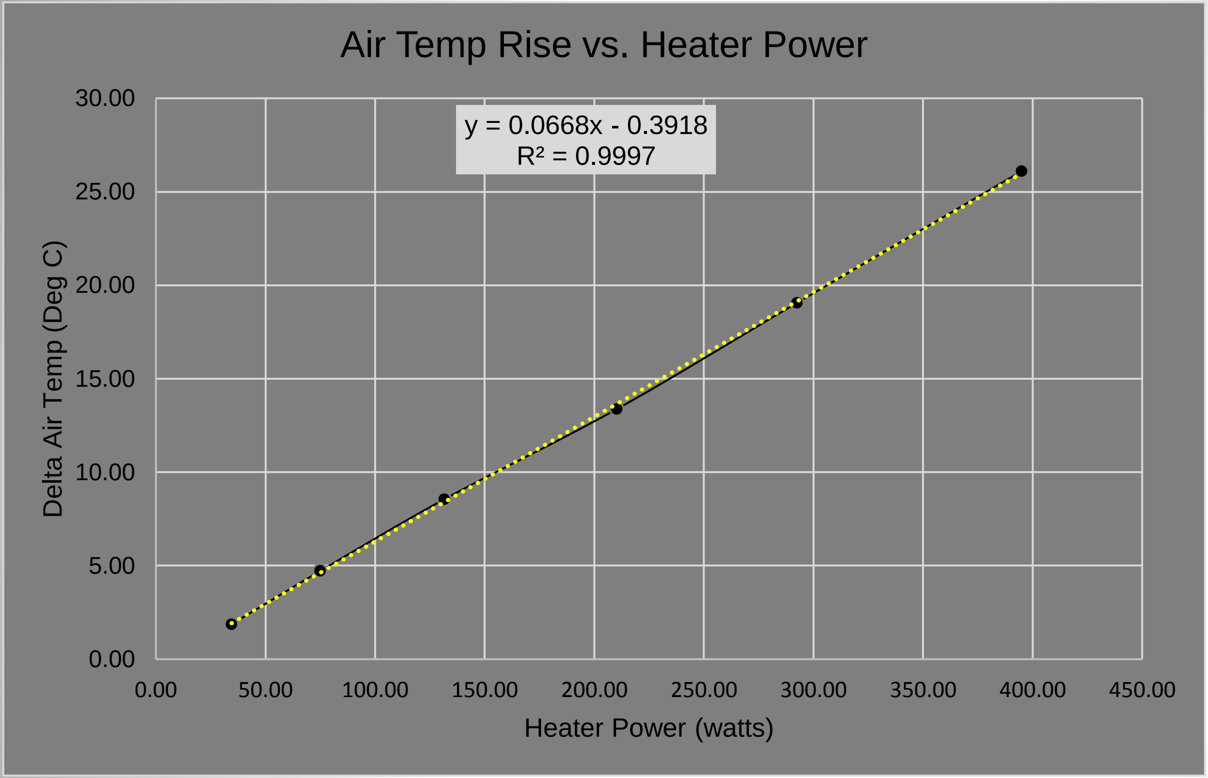
R_{HTR} vs. T_{HEATER}



Excel curve fitting app generates erroneous results, so read Y-value off graph manually

Heater Power vs. ΔT_{AIR} Plot: Inert Capsule

Yields a linear plot over entire range of interest for temperature and power.



Duty cycle = 0.76

$R_{CABLING}$ = 0.3439Ω

V_{PS} = 10.00V, 15.00V … 35.00V

$I_{DC} = V_{PS}/(R_{CABLING}\ R_{SWITCH} + R_{SHUNT} + R_{HEATER})$ where R_{HEATER} is read off previous graph

$P_{HEATER} = I_{DC}^2 * R_{HEATER}$ * Duty Cycle

Power calculated via above method is slightly higher than taking Duty Cycle * $V_{HEATER\text{-}DC}$ * $I_{SHUNT\text{-}DC}$. This is due to the slightly lower R_{HEATER} value when applying chopped DC, as opposed to pure DC

Comparison of Inert vs. Loaded Capsules

No excess heat