PD power, Vpse and Rcable

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Cable current

- The equation for Icable is a quadratic:
  - $R * I^2 – V_{PSE} * I + P_{PD} = 0 \Rightarrow I = ((V_{PSE} \pm SQRT(V_{PSE}^2 – 4 * R * P_{PD})) / 2 * R)$
    - The 'plus' solution is an unstable mode, use on the 'minus' solution
  - $P_{PSE} = V_{PSE} * I$

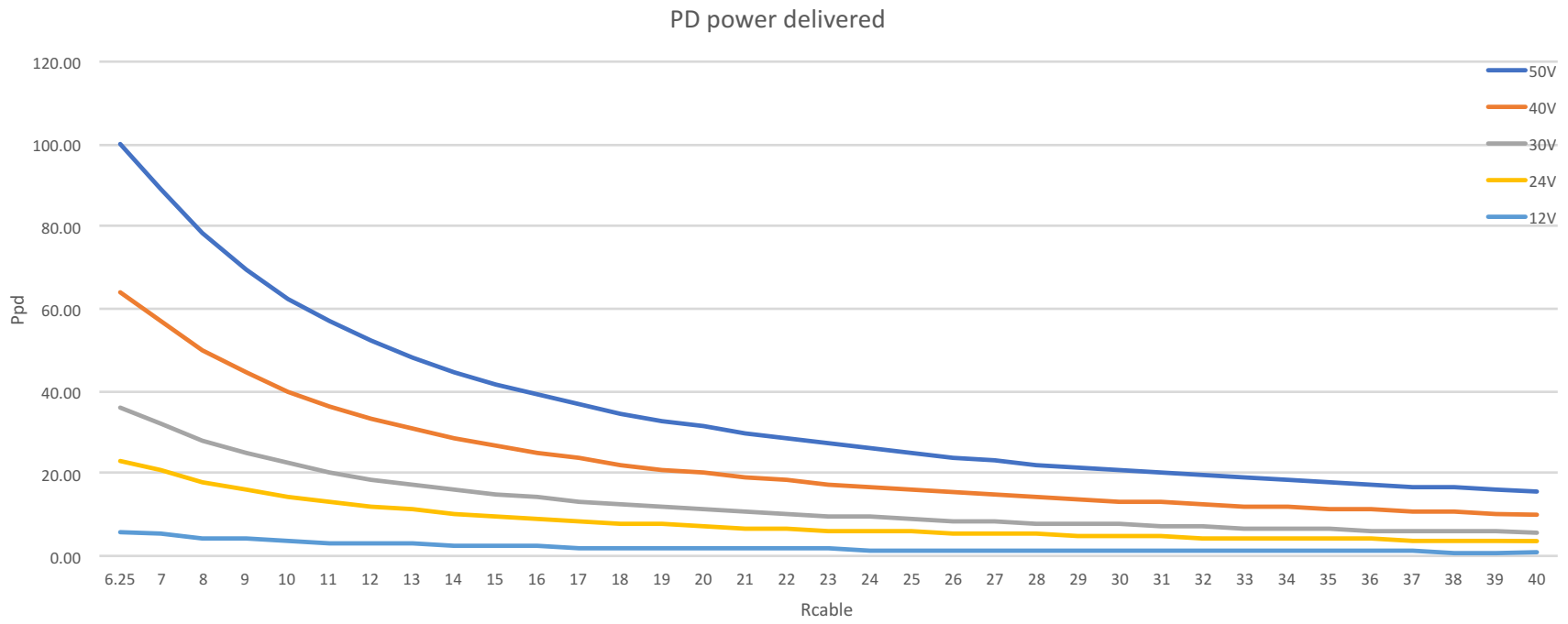
$$P_{PSE} = V_{PSE} ((V_{PSE} – SQRT(V_{PSE}^2 – 4 * R * P_{PD})) / 2 * R)$$

Max Current, Max PD power

- The max of that quadratic can be found by taking the derivate wrt I, solving for I. But I don't really care about I_{MAX} as much as I want to know P_{PD_MAX}
- P_{PD_MAX} occurs when $P_{PD} = P_{CABLE}$
- (P_{PD}) $V_{PSE} * I – R * I^2 = R * I^2$ => $V_{PSE} * I = 2 * I^2 * R$ => $I = V_{PSE} / 2 * R$
- And $P_{PD} = V_{PD} * I = (V_{PSE} / 2) * V_{PSE} / 2 * R = V_{PSE}^2 / 4 * R$

$$P_{PD\_MAX} = V_{PSE}^2 / 4 * R$$

Which is more important, R_{CABLE} or V_{PSE}



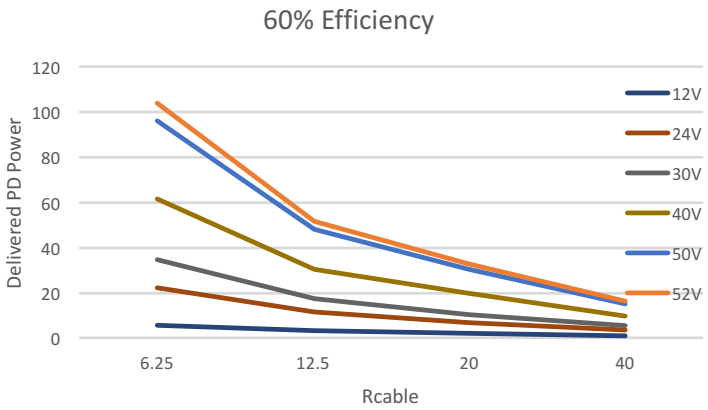
Efficiency

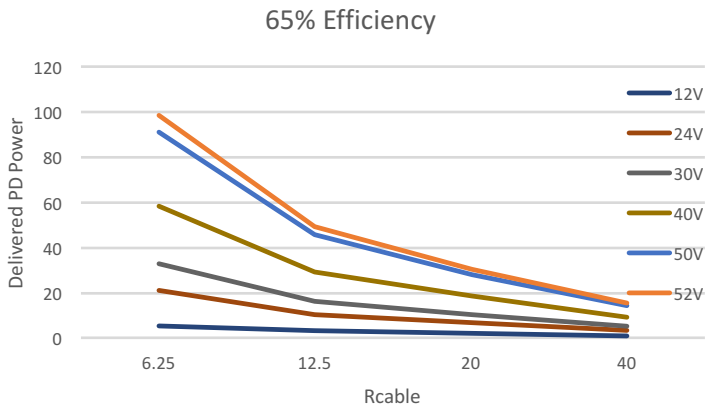
- The problem with the previous analysis is it ignores efficiency
  - It's not ignored, it's just 50%.

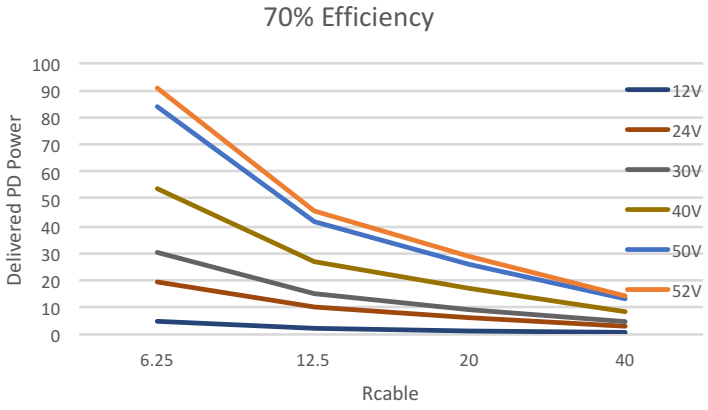
STANDARD/TYPE	V_{PSE}	R_{CABLE}	P_{PSE}	P_{PD}	EFFICIENCY
AF	44V	20 Ohms	15.4W	13W	84%
AT	50V	12.5 Ohms	30W	25.5W	85%
BT Type 3	50V	6.25 Ohms	60W	51W	85%
BT Type 4	52V	6.25 Ohms	91W	71.3W	78%
BT Type 4*	52V	6.25 Ohms	100W	75W	75%

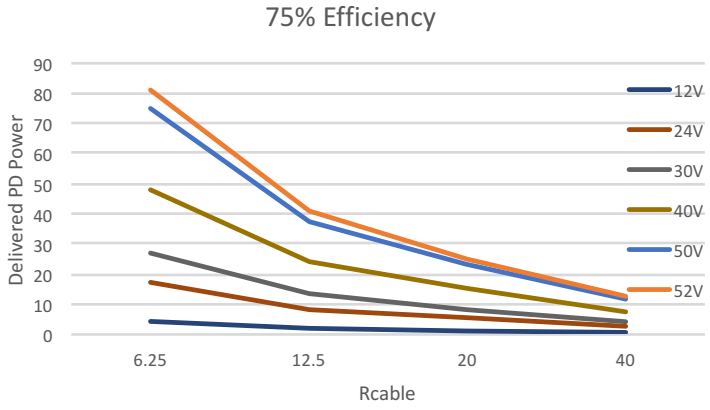
*802.3bt does not have a 100W P_{PSE} mode, this is the theoretical max for demonstration purposes

How does efficiency affect power delivered?









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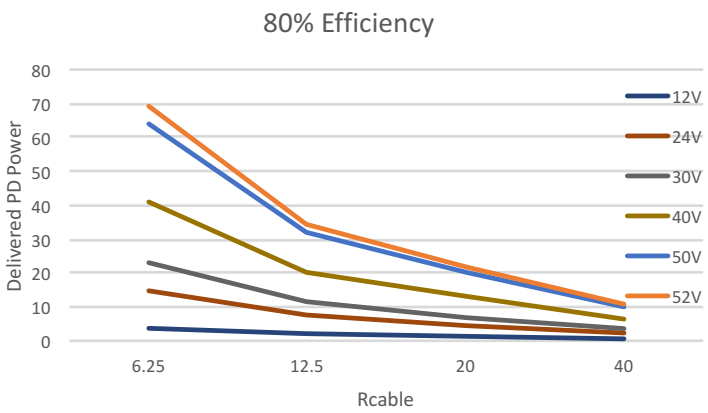
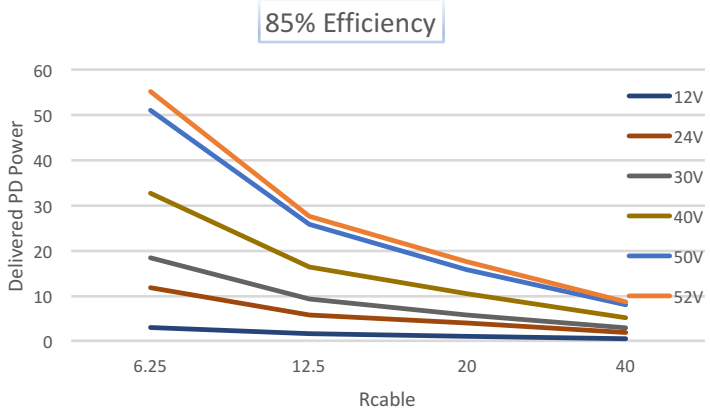
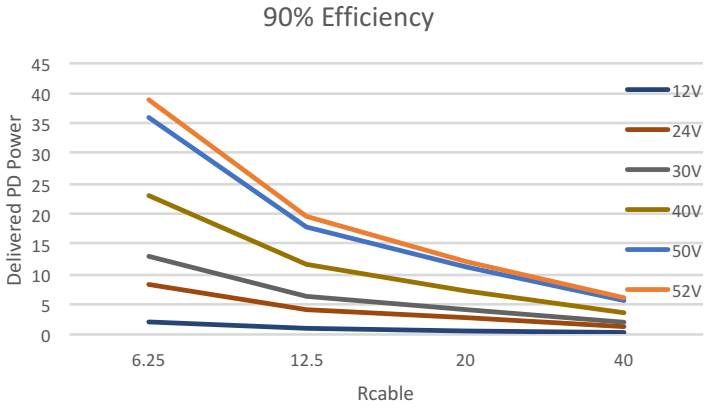
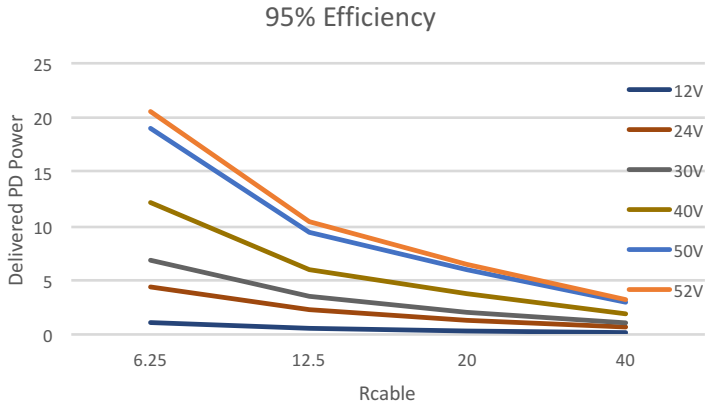






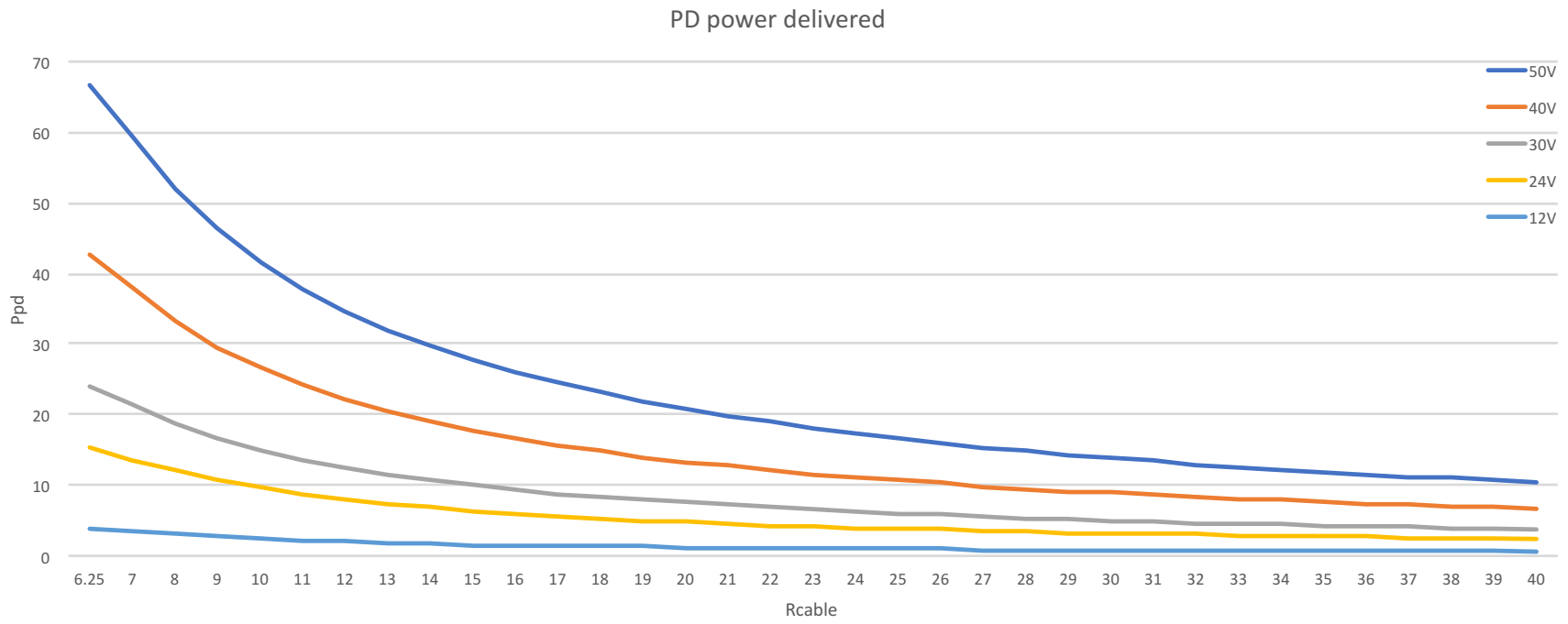


Efficiency

More realistic: $P_{PD} = V_{PSE}^2 / 6 * R$

This yields an efficiency of about 80% and is good simple guide to estimate power delivered to a PD

More Realistic Efficiency



Conclusions

- Need to keep V_{PSE} higher, R_{CABLE} lower.
- Target worst case efficiency of about 80%.
- 12V V_{PSE} is a tough target. Looking at less than 4W P_{PD}.
- 24V can deliver about 10W over 10 ohms.
- Can get significant power from 50V with a reasonable R_{CABLE} (10 ohms is about 42W).