

Megawatt Static WPT:

T-type Mechanical design and part optimization

Daniel Ashby (Utah State Univ.), Matt Jones (Utah State Univ.), Mahmoud Mansour (Utah State Univ.), Bryce Hesterman (Utah State Univ.)

Background

The T-types are a component of the megawatt charging system whose purpose is to increase the frequency of stepped dc voltage. They consist of 16 shelf units, half of which are mirrored.

Requirements

- The T-types shall fit in the existing cabinet shelf 29 in x 36 in x 6.75 in
- Parts shall be designed such that it minimizes number of unique parts
- Comply with UL electrical isolation standards
- The shelf must adequately support the weight of all components

Tuning Capacitor shelf:

This bracket not only holds and isolates the tuning capacitors but also keeps the brackets below it properly aligned .

Main Busbar:

The main busbar connects the capacitor bank to the AC Switch Board. Using a flat busbar would deflect too much with pressure from the brackets above causing insufficient contact area. Using U-channel proved to be effective in minimizing the deflection and providing adequate contact area to the cap banks underneath.

Universal Cold Plate:

The cold plate was designed to maximize cooling by having densely packed copper tubing. It was also designed to have mounting holes for the capacitor module, the inductor module, and their mirrors as well so they could be used on the right and left side T-type.

Busbar Bracket:

The brackets serve the purpose of providing pressure on the cap banks below, while also abiding by creepage and clearance requirements. They also secure the entire capacitor assembly to the baseplate.

Cap Banks:

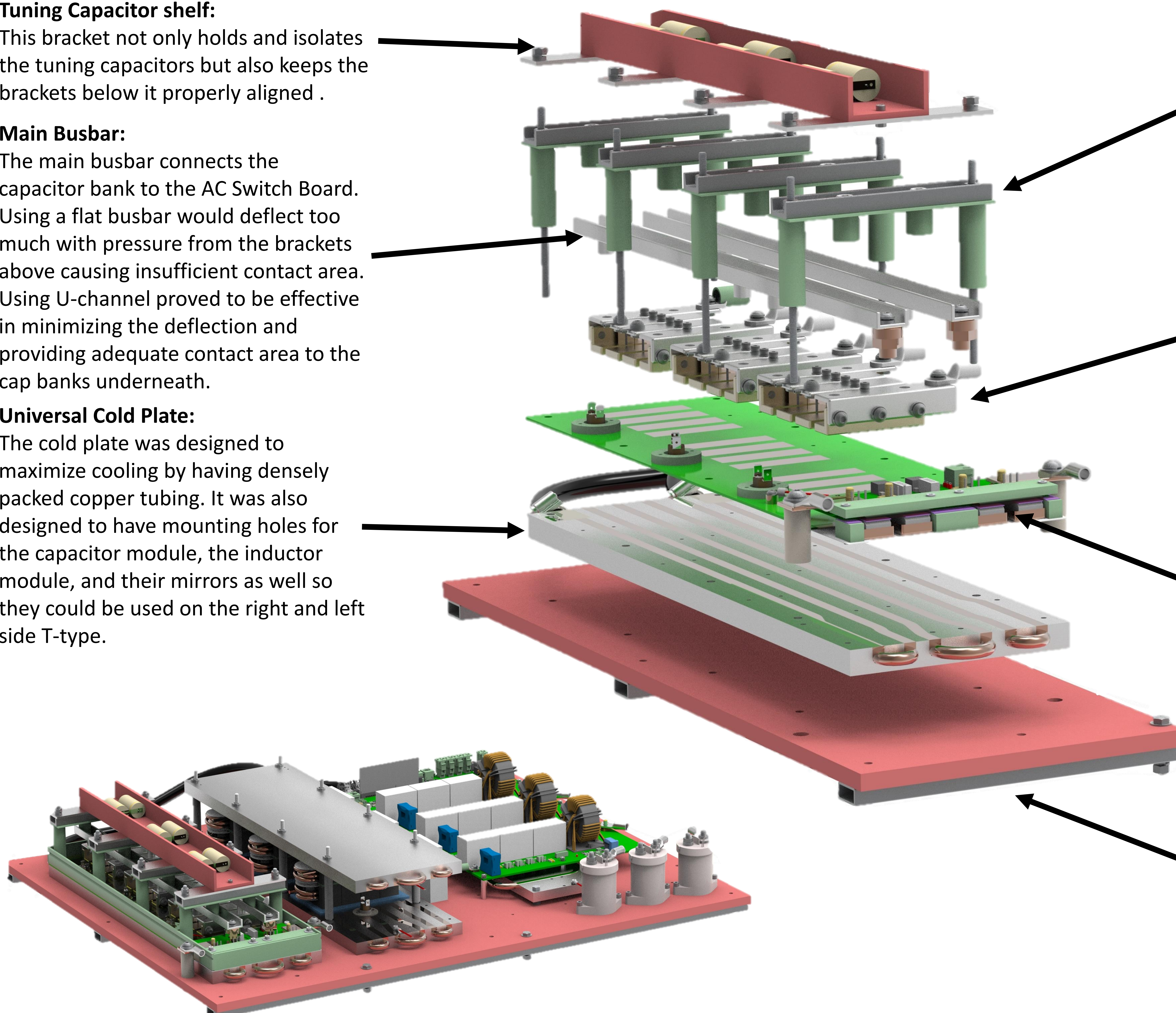
The capacitor banks were designed to hold rotational symmetry so the same parts can be used on either shelf greatly reducing unique part count. The 3 banks also alternate polarity such that the sides of the same polarity are adjacent. This reduces concern for electrical isolation while making a more compact design.

IGBT Cooling:

The 1KA sheets proved to be insufficient for cooling the IGBTs, so they required a more efficient cooling solution then the capacitors. The IGBTs sit on thinner, more thermally conductive ceramic sheet while uniform pressure is supplied by a g10 cross piece which maximizes thermal transfer and cooling.

Base Plate:

The base plate was originally made out of a sheet of Garolite-10 fiberglass, however, that proved to be extremely costly. Using steel tubing and a cheaper sheet of GPO-3 fiberglass was shown to have minimal deflection as well as provide adequate electrical isolation while cutting costs by over 75% (roughly \$50,000).



Conclusion

In conclusion, the t-types were designed to be cost effective and fit within a compact space all while following creepage and clearance constraints. Minimizing custom made parts and replacing them with off-the-shelf parts that required little to no modification was also crucial for reducing costs.