Team 21: Portable Charging System for Electric Vehicles

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Project Background

With the impact of climate change and people becoming increasingly concerned with pollution, EVs have become a cleaner and often cheaper alternative. EVs technological limitation is their battery range and charger availability. These limitations have caused owners “range anxiety” which occurs when the driver fears a lack of an available charging infrastructure when their Guess-O-Meter (GOM) displays a low charge. By designing a portable EV charger that can charge the vehicle anywhere, drivers can have the peace of mind knowing that they will have extra power available to reach the next charging station.



Project Goal

- The goal is to design and test a level 2 portable EV charger for MathWorks.
- The external battery design specifications are determined based on charging common EV's on the road today to increase the distance they can travel by up to roughly 20 miles.
- The electrical and thermal characteristics of the intermediate power electronic charging circuit model must meet an acceptable range.

Overall Design Approach

Grid Connection → Battery Bank → Boost Converter → Inverter → J1772 Connector → Rectifier → Boost Converter → MSCCCV → Battery Bank

Battery Composition

- We looked at four different batteries; A standard lead battery, Nickel Metal battery, a Solid-State battery, and we chose Lithium-ion batteries because they fit our design goal.

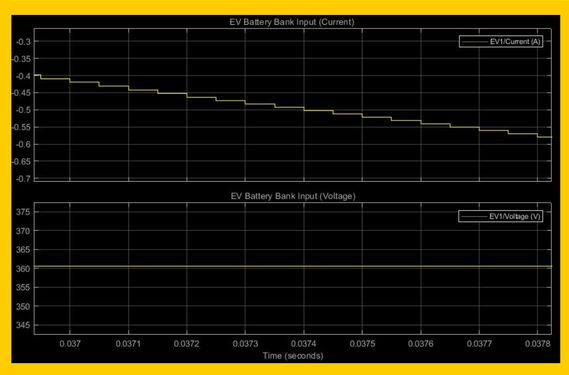
Level 1	Level 2	Level 3
120V	240V	400-900V
3-8 Miles for full charge	3-8 hours for full charge	30 Minutes for full charge
$379-$495	$329-2700	$50,000+

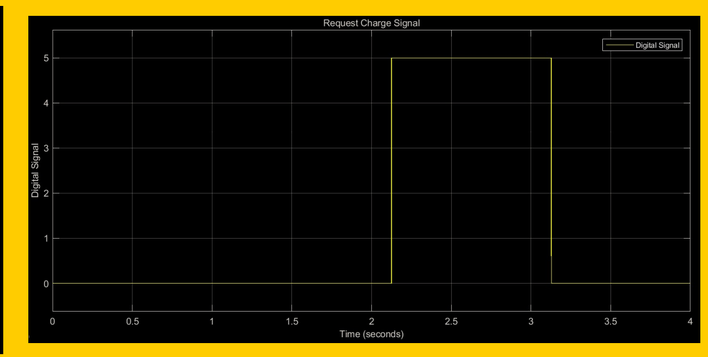
System Level Requirements

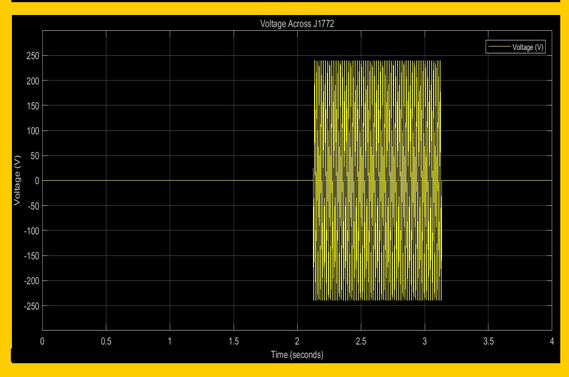
Vehicle	kWH consumption per 100 miles (kWh)	Cargo Space
Tesla Model 3	24	15 cu.ft.
Chevrolet Bolt EV	28	16.9 cu.ft.
Nissan Leaf	30	23.6 cu.ft.
Average:	3.6905 kWh/Mile	18.5 cu.ft.

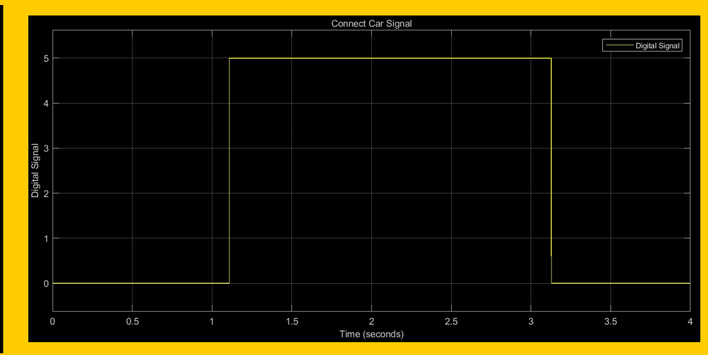
No.	Components	Values
1	Charging Standard	SAE J1772
2	Input Voltage	240 VAC
3	Output Voltage	240-220 VAC
4	Battery Chemistry	Lithium-Ion
5	Battery Nominal Voltage	150 V
6	Battery Rated Capacity	46.6 Ah
7	Battery Capacity	7kWh

Simulation Results



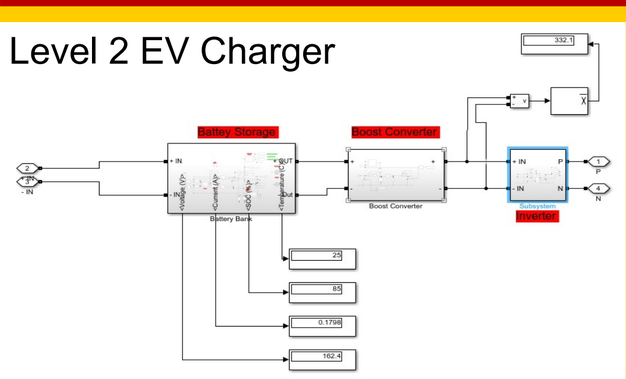




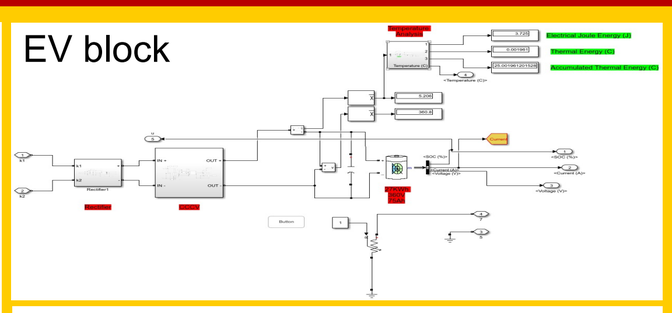


Results

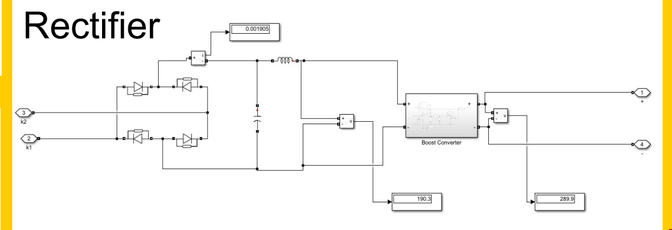
Level 2 EV Charger



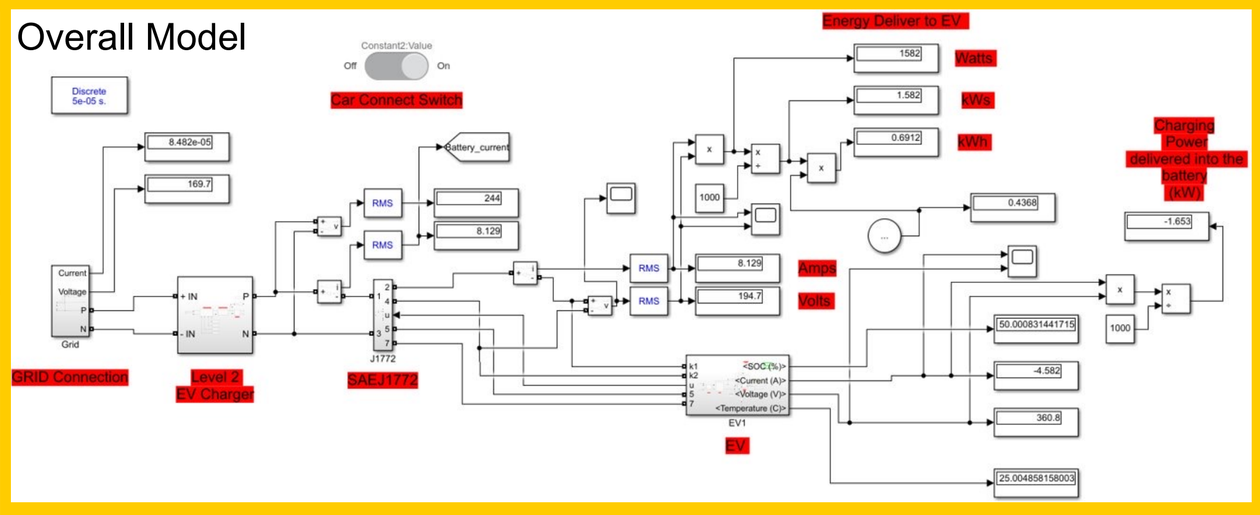
EV block



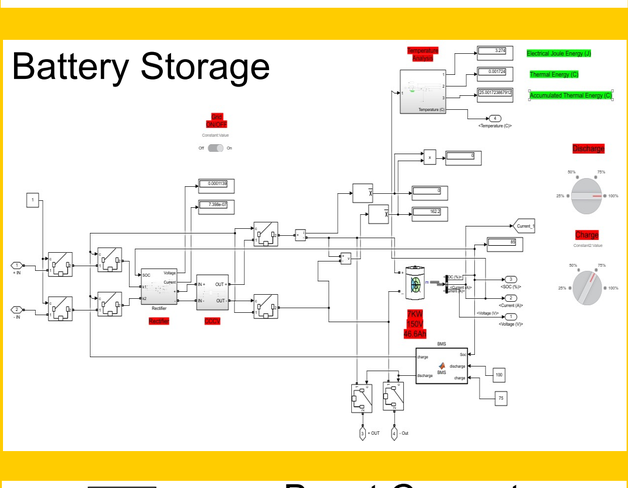
Rectifier



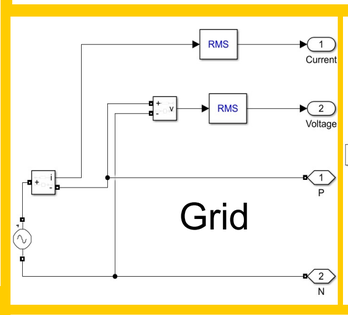
Overall Model



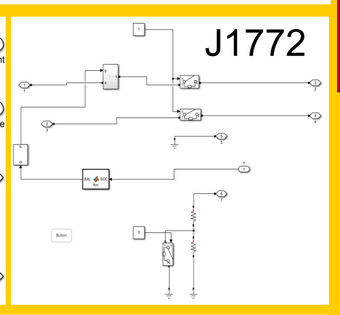
Battery Storage



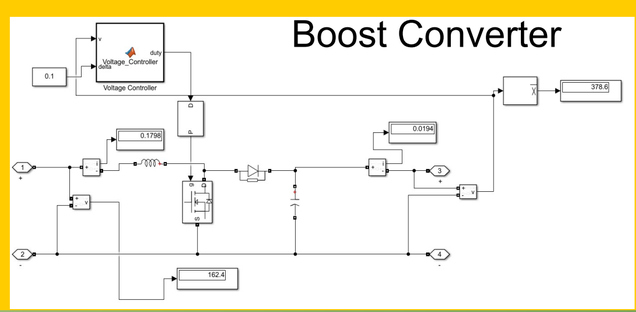
Rectifier



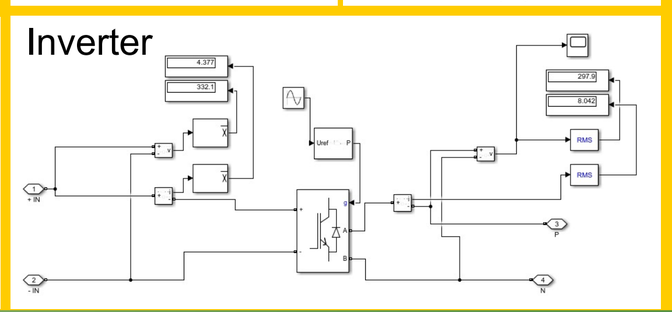
J1772



Boost Converter



Inverter



Conclusions

- Successfully design a Battery Pack that can charge an EV in an emergency using MathWorks Software exclusively
- Successfully able to simulate different power electronic components such as rectifiers, inverters, and boost converters
- Analyzed and Verified results through simulation

