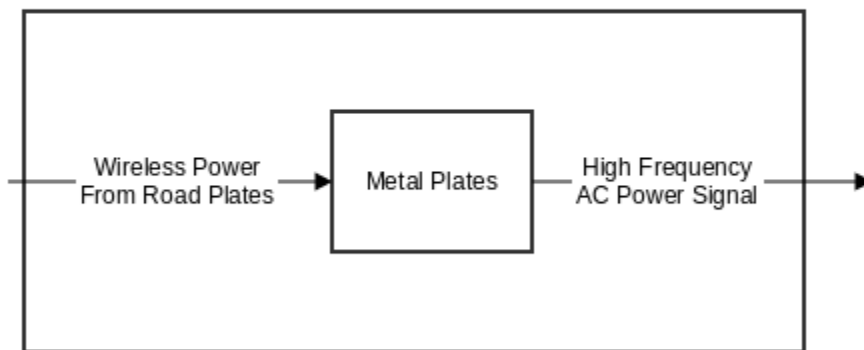


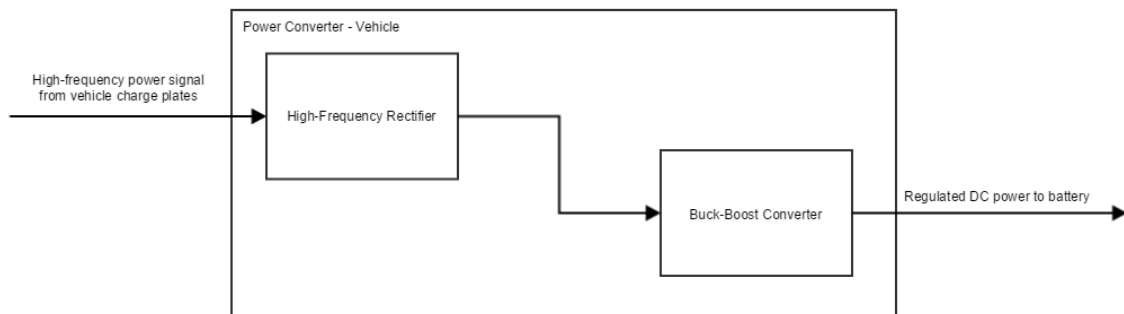
1.1 Functional Decomposition Level 2 - Vehicle System

Charge Plates - Vehicle



Module	Metal Plates
Inputs	Wireless power from road plates
Outputs	High frequency AC power signal
Functionality	Receives wireless power from road charge plates
Testability	Transmit power from another charge plate, and measure received power signal.

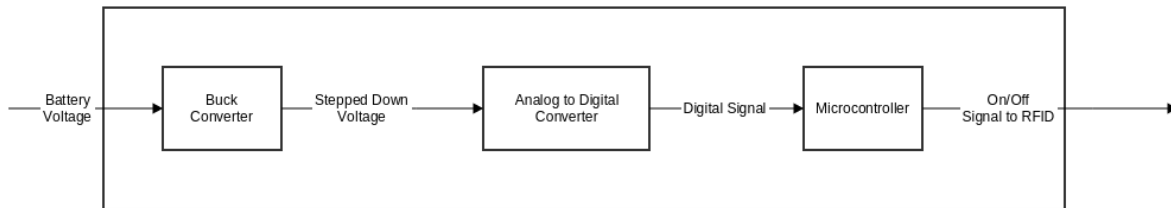
Power Converter - Vehicle



Module	High-Frequency Rectifier
Inputs	High frequency power signal from the vehicle charge plates
Outputs	DC power to vehicle buck-boost converter
Functionality	Converts the high frequency AC power signal to a DC power signal
Testability	Input a high frequency AC power signal, and measure the output signal to ensure that it is DC

Module	Buck Boost converter
Inputs	DC power from high-frequency rectifier
Outputs	Regulated DC power to battery
Functionality	Converts the DC power signal from the high-frequency rectifier to the appropriate voltage level for charging the vehicle battery
Testability	Sweep the voltage range for the input and confirm output voltage range can charge the battery

Charge controller - Vehicle

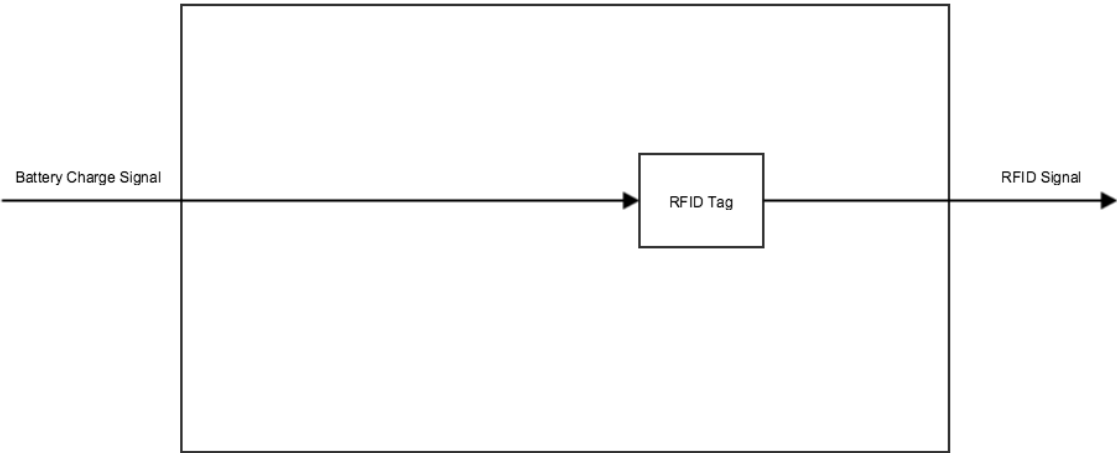


Module	Microcontroller
Inputs	Data that indicates vehicle's battery level
Outputs	Voltage to control RFID tag
Functionality	Turns the RFID tag on or off based on whether the car battery is fully charged.
Testability	See if a full battery signal results in the RFID tag being turned off, and if an uncharged battery turns the RFID tag on.

Module	Buck Converter
Inputs	High voltage signal from battery
Outputs	Low voltage signal for input into analog to digital converter.
Functionality	Steps down the voltage level of the battery so that it can be an input into the analog to digital converter.
Testability	Sweep the input of the buck converter from lowest possible voltage to battery's max voltage and see if all output signals have a lower output voltage.

Module	Analog to Digital converter
Inputs	The scaled down analog signal from the buck converter.
Outputs	A digital signal indicating battery charge to the microcontroller
Functionality	Converts the analog signal from the buck converter into a digital output so that the microcontroller can analyze the signal.
Testability	Sweep the input of Analog to digital converter from the minimum value of the buck converter output to the maximum value of the buck converter output and see if the digital signal has appropriate resolution.

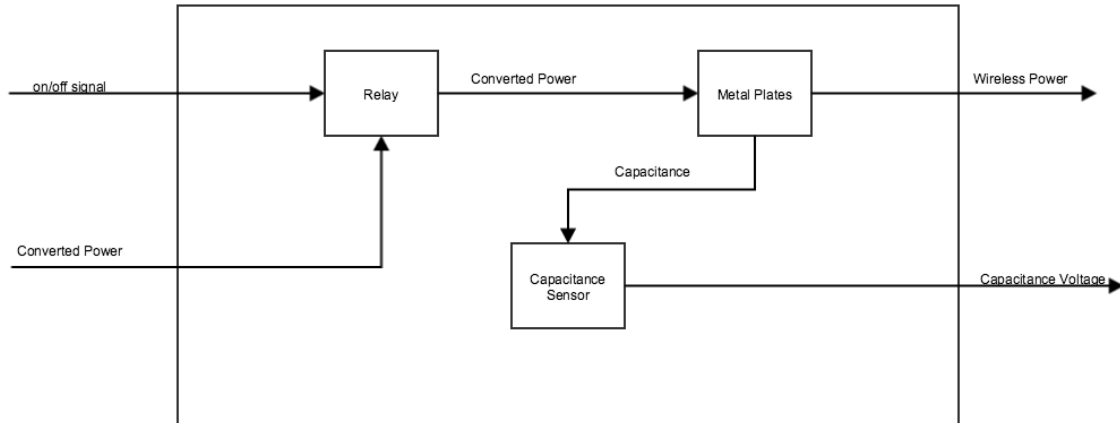
RFID Tag - Vehicle



Module	RFID Tag
Inputs	Battery charge level
Outputs	RFID signaling desired charge behavior
Functionality	Transmits an RFID signal when the vehicle battery needs charging
Testability	Give the RFID tag a digital battery voltage level, and measure the resulting output signal with an RFID reader.

1.2 Functional Decomposition Level 2 – Road System

Charging Pads - Road

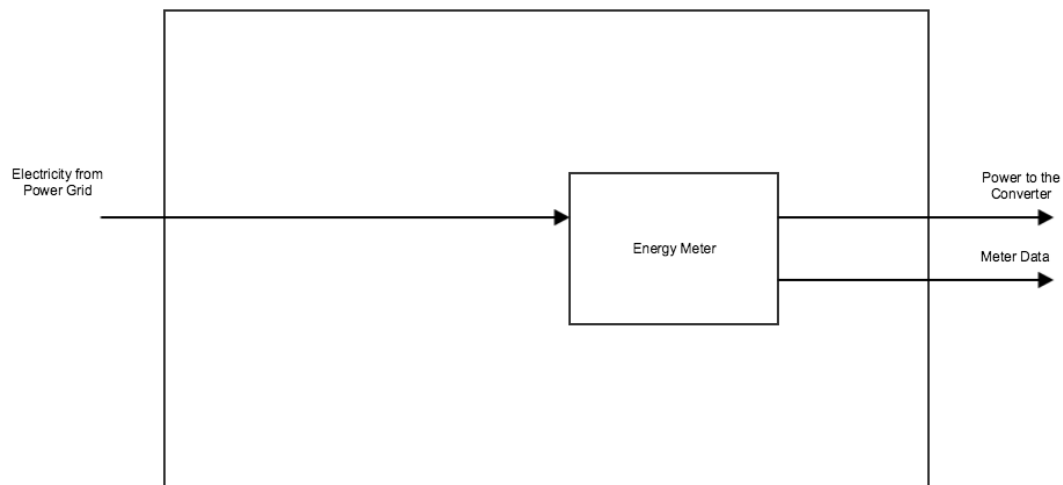


Module	Metal Plates
Inputs	Scaled AC voltage from the relay
Outputs	Wireless power to vehicle charge plates
Functionality	When the controller desires the plates to be on, the road plates provide two phase-shifted signals to the vehicle plates.
Testability	Provide an AC voltage signal and measure transmitted signals using a matching set of vehicle plates and an oscilloscope.

Module	Relay
Inputs	On/off signal, scaled voltage from the frequency converter
Outputs	Scaled AC voltage to road plates
Functionality	When the relay is turned on by the control logic, the scaled AC voltage passes through; otherwise, the plates will remain unpowered.
Testability	Use an oscilloscope to measure the power transmitted when the relay is on, and when it is off.

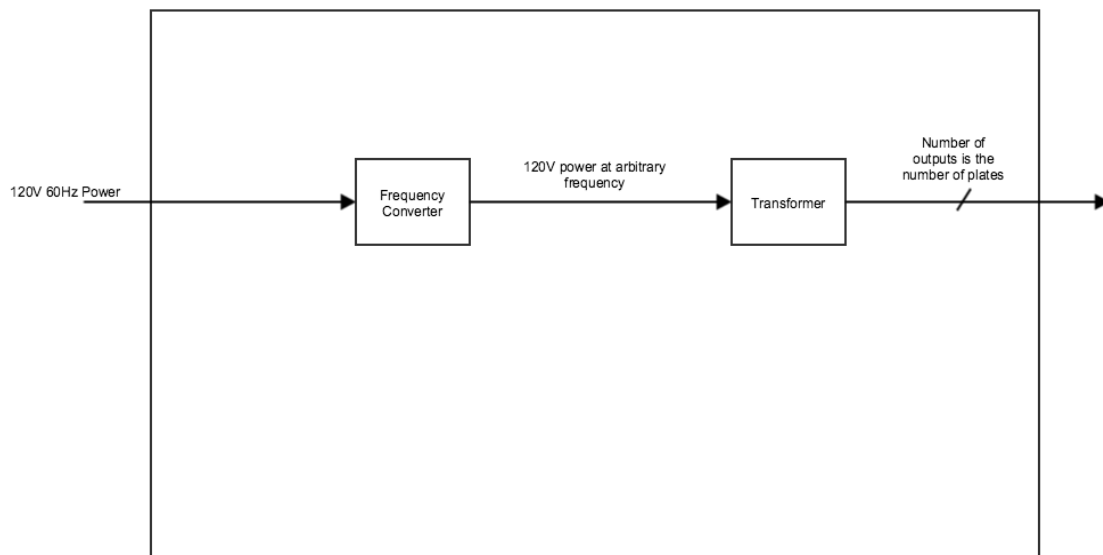
Module	Capacitance Sensor
Inputs	Capacitance from the Road Capacitive Plates
Outputs	A digital level to determine if the plates need to be on or off.
Functionality	Determines the capacitance of each individual plate in order to turn the plates on or off based on if the vehicle is above the plate or not.
Testability	To test, put different capacitances as the input to the circuit and see if the output value is correct for that capacitance.

Energy Meter -Road



Module	Energy Meter
Inputs	Mains electric power from the power grid
Outputs	Data about power usage to road microcomputer, power to the frequency converter
Functionality	Measures how much energy is being used.
Testability	Put a load on the end of the circuit that has a known power consumption rate, and make sure the energy meter's measurement matches the known power consumption.

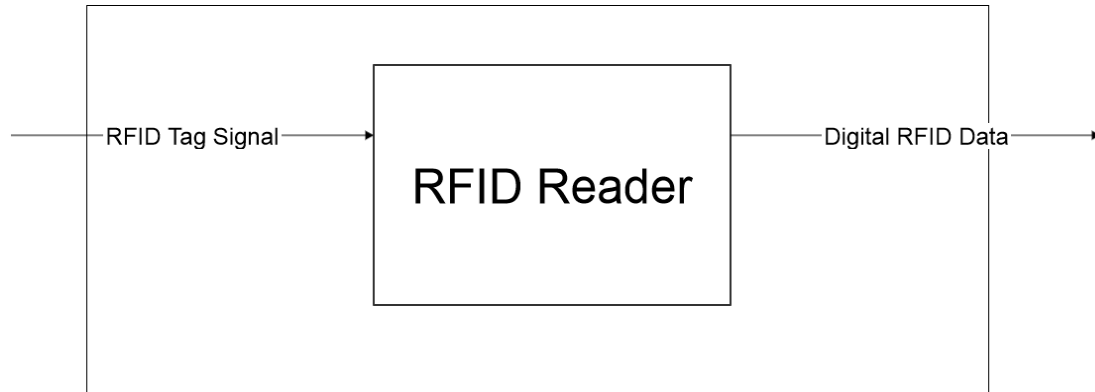
Frequency Converter - Road



Module	Frequency Converter
Inputs	60Hz power from the meter
Outputs	Power to the transformer at arbitrary frequency
Functionality	Converts 60Hz signal to a signal on the order of megahertz
Testability	Measure output frequency given appropriate input frequency, using an oscilloscope

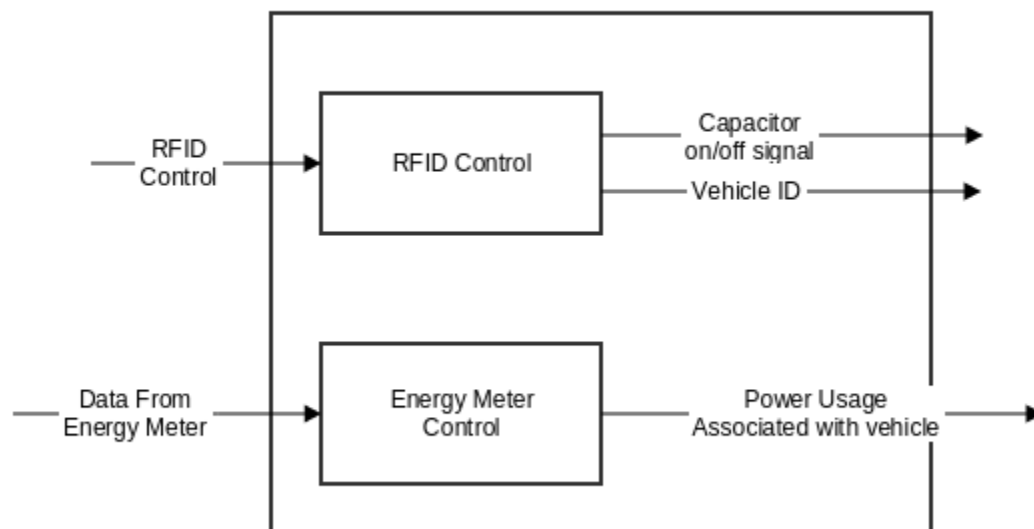
Module	Transformer
Inputs	120V power from the Frequency Converter
Outputs	Power to all of the plates
Functionality	Converts the RMS Voltage of an input power source to one that is more efficient for transmitting wireless power.
Testability	Measure output voltage given input voltage, using an oscilloscope

RFID Reader - Road



Module	RFID Reader
Inputs	RFID tag signal
Outputs	Digital RFID data
Functionality	Reads the RFID tag and transmits the Identification Number of the vehicle with information requesting power to the on/off block
Testability	Have the RFID reader scan the RFID tag for two cases. The first case is when the vehicle wants power, and the second case is when the vehicle does not want power.

Microcomputer - Road



Module	RFID Control
Inputs	RFID Reader Data
Outputs	On/Off signal to Road Capacitive Plates and Identification of Vehicle to Metering System
Functionality	The purpose of this block is to read in the RFID Data and process it to see if the vehicle passing by needs to be charged. It also processes the vehicle ID to send to the metering system.
Testability	Send an RFID reader signal and verify if it accurately outputs both the correct on/off signal and vehicle identification information.

Module	Energy Meter Control
Inputs	Data from energy meter
Outputs	Power usage associated with vehicle
Functionality	Tracks the power usage for each vehicle
Testability	Input synthetic data and verify output