**MATLAB/Simulink-Based Analysis of Electric Vehicle Power Transfer Systems**

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**Abstract:**

The increasing demand for sustainable energy solutions has driven research in wireless power transfer (WPT) systems, particularly for electric vehicle (EV) charging. This study presents a simulation of a wireless power transfer system for electric vehicles using MATLAB/Simulink. The focus is on modeling and analyzing the performance of different power sources in the WPT system. The simulation includes inductive power transfer (IPT) mechanisms, with detailed consideration of circuit components such as resonant capacitors and inductive coils. The simulation provides waveform analysis for various power sources, including sinusoidal and pulse-width modulation (PWM) signals. By varying the parameters of these sources, the impact on efficiency, power transfer, and electromagnetic compatibility is examined. The results demonstrate the effectiveness of different source configurations in optimizing power delivery while maintaining minimal losses. The generated waveforms offer insight into the operational characteristics of the WPT system under different conditions, highlighting the potential of advanced control techniques in improving system performance.

**Keywords:** Wireless Power Transfer (WPT), Static Charging, Power Flow Analysis, Power Transfer Efficiency, Static Charging and Electric Vehicle (EV).

**1.Introduction:**

Electric power is utilized in industrial and domestic purposes. Traditional wired transmission system has distance as well as loss limitations. There is no wire usage WTPS system enables transmission of electric power. Wireless transmission is not new. Although it is not utilized on a large scale. Electricity can be wirelessly transmitted without even using wires and batteries. Wireless transmission can be used to supply power to devices when it is not possible to connect them. All devices will be conversing wirelessly with the power source in the future. Every one of the wireless transmissions possesses its own features and application. Wireless power transmission has varied applications like LED lighting, defence system, industrial use, implementable medical device, electric vehicles. Because of growing environmental pollution in fuel vehicles, individuals are keen on electric vehicles.

There are different modes of wire-less transmission and all these forms or techniques Each has its own distinctive traits and features. Wireless power transmission is useful in many things including • LED lighting • Defence systems • Artificial surgery concrete medical devices with solid foundations for implementation and Reality Electric Vehicles. The main shortcomings associated with conventional electrical car charging facilities are as follows B. Charging time is 2-3 hours, and the transmission and distribution loss is 25-30%. Because of all these disadvantages, the idea of wireless charging is adopted in electric cars. Charging of electric vehicles through wireless charging is easy. As for the wireless charging, it has quite many beautiful color solution on the pCBoad. As we have earlier noted, one of the principal advantages of the inductive coupling method is that is inexpensive and safe. Thus, it is It works perfectly for 19-inch electric vehicles. to certain extent. Moreover, since battery performance of an electric vehicle is related with the engine and vehicle dynamics, the bicycle is classified as an electric vehicle. Thus, the engine and the vehicle behavior are determined. Thus, the motor power of ELV is 48V, 1000w, the battery power also is 48V, In this study, we design a wireless system designed to charge the 48V battery.

The growing global economy is encountering the destruction of fuel resources with risky disturbances in environmental conditions. Additionally, it has encouraged the development of sustainable technologies resulting in innovations in large carbon contributors, i.e., transportation [1], [2]. Thus, electric vehicles (EVs) are embraced as a solution to reduce the environmental impact due to carbon-based fuels [2], [3]. Additionally, the EVs market presents a new chance for human beings to extend the life span of transportation at reduced cost [1], [3]. Previously, the battery technology (BT) and power shaping technologies are the constraints to render EVs out of market success. However, BT has been developed with high energy density, lower weight, and high efficiency in a few previous decades [4]. Furthermore, efficient energy storage device enhances overall performance when used with an appropriate power shaping circuit. A dc–dc power conditioning configuration with subservient power losses, long-lasting, reliable energy transfer, and higher charging-discharging cycles are practiced by researchers and industries [1]– [4]. Currently, efficient, quick chargers are used for short driving range with human safety issues. In the current situation, the inductive power transfer (IPT)-based typologies are used as safer battery charging (BC) solutions during EV stationary and dynamic mode. Compensation networks are introduced to crimp the circuit impedance for enhancing the overall efficiency of the converter. However, the number of active and passive elements of the circuits includes with the complexity of the configuration [5].

**2.Proposed System**

**2.1. Introduction:**

Wireless power transfer (WPT) is gaining an increasing amount of attention towards electric vehicle (EV) battery charging. Efficient source-to-load power transfer is the work of resonant WPT systems. A review of two-element resonant compensation techniques and their behavior under various operating conditions are presented. The converter and control strategies used for different topologies are also presented. The behavior of the performance factor is studied with respect to the operating conditions and compared for different topologies**.**

**2.2. Electric Vehicle:**

Electric vehicles (EVs) were initially introduced in the mid-19th century, when electrical was the most popular power sources for autos. They offered a degree of convenience and practicality that the gasoline-powered cars of the day could not match. Although cars and trucks were mostly propelled by internal combustion engines for many years, electric power was widely utilized for over a century in other kinds of vehicles, such as railroads and smaller vehicles of different kinds. While railroads and smaller vehicles of all types remained to mostly rely on electric power, automobiles and trucks were powered primarily by internal combustion engines for around a century. Some of the factors propelling the resurgence of EVs in the twenty-first century include a stronger focus on renewable energy, technological developments, and the potential to mitigate the negative effects of transportation on air pollution, climate change, and other environmental issues. The electric cars are well captured under project drawdown among the top one hundred contemporary solutions for climate change. Some key political initiatives for adoption that was actively supported by the US and the EU on the second half of 2000s also helped vehicle industry growth in the 2010s. The main factor driving this growth is the increasing public interest and awareness coupled with incentives governed by institutions such as those in the COVID-19 green recovery. The COVID-19 pandemic has forced people to sit at home resulting in reduced emissions of greenhouse gases from petrol and diesel vehicles. IEA’s 2021 report also urged countries to move further in achieving climate goals: ‘The governments should pass laws regulating large electric vehicles. Electric cars sales might reach 30 percent market in 2030 if compared with just 2 percent in 2016. North America, Europe and China is likely to drive increase in demand for digital media advertising during this period. A 2020 review of literature suggested that although, there is expected increase in electric two wheeler, there is no expectation of an increase in sales of electric four wheelers in emerging economy in terms of economy. Of all such vehicles, those with two or three wheels remain the most common.

**2.3 Battery Charger:**

By passing an electric current through a battery, a device known as a recharger or battery bowl may store energy in the battery. The charging protocol depends on the type and size of battery being charged and dictates how much voltage or current to use for how long and what to do once the charging process is over.

Depending on the kind of battery, it may be possible to recharge it by connecting it to the source of steady voltage or current. Additionally, these battery types are very tolerant to overcharging, which is the process of charging a battery after it has reached full capacity. These types of basic dishes must be manually separated at the ending of charging cycle. Other types of batteries employ a timer to tell them when the charging process is complete. Other battery types cannot tolerate overcharging, overheating, deterioration [reduced capacity, decreased continuity], or even blowout. It may incorporate the temperature/voltage indefinitely along with a microprocessor regulating circuits for controlling the charging current and voltage, determining the charging status and shutting off after full charge. Fixing for resistance in cables, dishes may adjust the affair voltage in proportion with current. Just the right voltage is generated by a teardrop bowl to neutralize the tone-discharge from a long-term non functional battery.

In general, teardrop charging may compromise the integrity of some batteries that cannot handle the kind of charging it imposes. What one must remember is that indefinite teardrop charging is impracticable with lithium-ion batteries. Some battery dishes may take many hours to gain a full charge depending on how slow the batteries are. While high-rate dishes can bring the maximum capacity very swiftly, some battery kinds might not stand such temperatures. Due to overcharging risk detection, similar batteries are closely monitored. Appropriate research for high-rate dishes is essential to maintain the cleanliness of electric automobiles. The expected withdrawal of electric buses instincts questions con refers to electric dishes and management support of them as for the accessibility to community. Knowing when and how to charge an electric vehicle [EV] is one of the main issues that owners face. The ordinary American has spent their whole lives in gas-powered vehicles, topping up at any of the hundreds of thousands of gas stations as the gauge slowly approaches empty. Although charging an EV requires a bit more preparation, public EV charging stations are gaining more popularity because of the increasing demand and incentives for gas-powered automobile alternatives. Listed below are fundamental details about how an EV charger operates, regardless of whether you own an EV or want to install a public EV charging station on your business site.

A diagram of a single phase

AI-generated content may be incorrect.In a WPT based on an inductive coupling, the transmitting coil is excited, creating a magnetic flux that links to the receiving coil and creates electromagnetic force. This results in the production of electric power and the realization of WPT. The primary elements of the electromagnetic induction-based circuit depicted in Figure 1 are a DC-AC converter, an AC-DC converter for both the transmitting and receiving sides, a transmitting and receiving coil with a compensatory capacitor, a separate transformer, and a load [EV battery].

Fig. 2.1 Block Diagram for WPT

Resonant inductive coupling is a form of inductive coupling where energy is passed along magnetic fields from one resonant circuit (tuned circuit), one at the transmitter and one at the receiver. Each of these resonant circuits consists of a coil of wire and a capacitor, or an internally self-resonant coil or other resonator with internal capacitance. They are both adjusted to one resonant frequency so the two resonate alike. Resonance between coils can greatly enhance power transfer and coupling, much like a vibrating tuning fork can cause sympathetic vibration in a distant fork but also tuned to the same frequency.

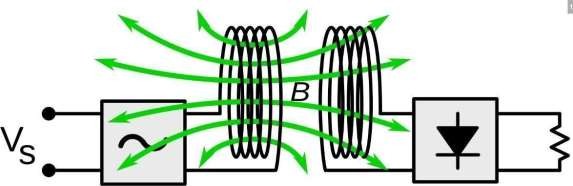


Fig. 2.2 Generic block diagram of an inductive wireless power system

In 2007, MIT researchers under the direction of Marin Spoljaric employed two linked tuned circuits to transmit 60 W of electricity across a distance of 2 meters [6.6 ft] with an efficiency of around 40% [83]. This is eight times the diameter of the coil. Each of the linked circuits consisted of a 25 cm wire coiled up, which was self-resonant at 10 MHZ. Also, the resonant circuits lose less power to absorption in other surrounding items as circuits with resonant frequencies respond to each other considerably better than circuits with non-resonant frequencies. It is disadvantage of the hypothesis of resonant coupling that, when two resonant circuits are in close connection, the system's resonant frequency “splines” into two resonant peaks, rather than to remain unaltered.

The maximum incident power is no longer achieved at the initial resonant frequency, suggesting that it is necessary to adjust the oscillator frequency to achieve a new resonance peak. Today’s inductive wireless power systems can use resonant technology. Wireless power transmittance within an area can be one of the applications using this kind of technology. In any location in a position, light and pocket permit devices could be wirelessly recharge through a coil mounted on the wall or ceiling with appropriate tools. Items that may include small ports charging them wirelessly just to save little costs and be environmentally friendly include clocks, music players, remote controls, and radios. The 6 billion batteries that are disposed of each year might be greatly reduced – this would decrease hazardous waste and contamination of groundwater levels.

A diagram of a circuit

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Fig. 2.3 Bipolar coupling

A study for the Swedish military found that 85 kHz systems for dynamic wireless power transfer for vehicles can cause electromagnetic interference at a radius of up to 300 kilometres.

**2.4 Capacitive Coupling:**

Capacitive coupling also In order to transmit power between two electrodes (the anode and the cathode) using electric fields, capacitive coupling, also known as electric coupling, produces an electric capacitance between them. As the opposite of inductive coupling, capacitive association or electrostatic induction. It allows using electric fields to transfer energy from one electrode to another electrode: for instance, metal plates. In some cases, when the medium between the transmitter and the receiver electrodes exhibits dielectric activity, a capacitor is created. An alternating potential is given electrostatically, in the receiving plate, by the oscillating electric field after the transmitter has transmitted an alternating voltage to the transmitting plate.

Thus, there is ACL in the load circuit. With regard to power transmission, the frequency contributes to the power transmission in addition to the capacitance between the plates which decreases with an increase in the spacing and is proportional to the size of the smaller plate. Unfortunately, only a few low power applications profit from capacitive coupling; to transmit substantial amount of power compulsory high voltages in the electrodes are required which might be dangerous and can lead to adverse effects like generation of poisonous ozone. Secondly, the dielectric polarization leads a strong coupling with most of the material in the universe or even in simple interactions in the human body in contrast with the magnetic fields. Between or near the electrodes, the energy may be absorbed by intermediate materials; in the case of humans, this could lead to excessive electromagnetic field exposure. Furthermore, the transmitter-receiver alignment criteria are given less attention. Capacitor coupling has recently been utilized to wirelessly transmit electricity constantly in biomedical implants, charge battery-operated portable devices, and transfer power across substrate layers in integrated circuits.

**Two circuits type have been employed**

In this type of circuit, there are two transmitter plates and two receiver plates. Each transmitter plate is coupled to a receiver plate. A circuit with a transverse [bipolar] architecture consists of plates are driven in opposing phase [180° phase difference] by the transmitter oscillator using a powerful alternating voltage. The two receiver plates are fastened to the load. The receiver plates experience opposing phase alternating potentials because of the alternating electric fields. An outcome of this "push-pull" movement via the load, current flows between the plates. The requirement that the two plates on the receiving device line up face-to-face with the charger plates in order for the device to function is a drawback of this wireless charging setup.

A passive electrode and an active electrode are also connected to the load. There is displacement of charges about the load dipole due to electrostatic induction which arises from the field generated by the transmitter. It also mentioned that the range is also extensible by adapting the use of both resonance and capacitive coupling. The first experiments with capacitive coupling as the resonant inductive coupling were started at the begun of the twentieth century by Nikola Tesla. **Magneto dynamic coupling**.

Meagrely, the electric motor rotor can turn the transmitter’s armature while a magnetic field from that motor turns the receiver’s armature. The armatures are connected mechanically by the action of an intervening magnetic field. By itself or when rotated with an independent electric generator, the receiver armature produces the power necessary to operate the load. This gadget has been proposed as a no contact electric car charging replacement for inductive power transmission. For a charging of batteries there was designed a revolving armature placed upon the curb or the garage floor turning in the bottom of the automobile a receiver armature. This method is said to achieve a power transmission efficiency of more than 90% for distances between 10 to 15 cm [4 to 6 inches]. Additionally, nearby electronic devices experience less electromagnetic interference.

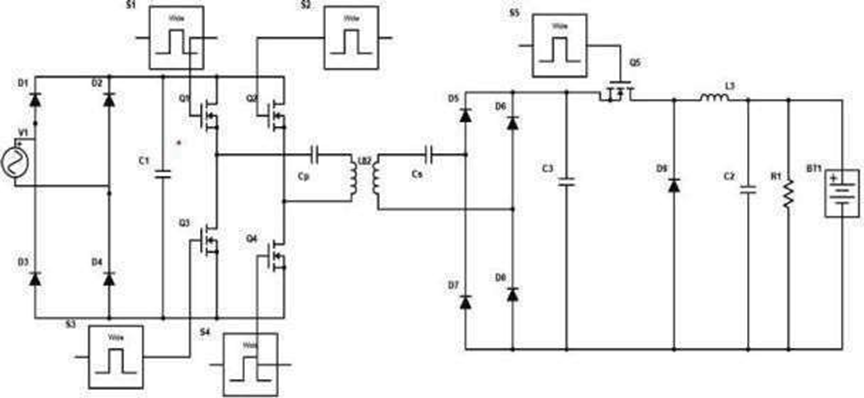


Fig. 2.4 Schematic of WPT System

A white background with black dots

AI-generated content may be incorrect.The schematic design for the WPT system, which charges e-bike batteries, is shown in Figure 2. Grid power [230V, 50Hz], primary side AC-DC converter, DC-AC converters [inverter], and primary coil are the parts of this e-bike wireless charging system. These four parts are installed at the charging station, while the secondary coil, secondary AC-DC converter, Buck chopper, and battery are installed in the EVs. A coil's design is crucial to the development of a wireless power transmission system. Additionally, various parameters must be calculated while building a coil. Coil parameter calculations are explained. Thus, the following equation is used to calculate the coil parameter.

From all above equation 1,2,3 and 4 we can obtain the coupling coefficient, primary side self and secondary side self, and mutual inductance. Which are tabulated below?

A table with text and numbers

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A table with numbers and text

AI-generated content may be incorrect. Table 2.1 Selected Value for Coil

A table with text and images

AI-generated content may be incorrect. Table 2.2 Calculated Parameter for Coil

Table 2.3 Selected Values for Buck Chopper

A white background with black and white clouds

AI-generated content may be incorrect.Power at Receiving side of the coil is at receiving side. Receiving side rectifier is gives 123.5V. But here required voltage is but here required voltage is 48V for battery charging. For conversion, DC 123.5V to 48 V design of buck chopper is required. Selected values for the buck chopper are mentioned in table 3 [10]. Table 4 mention the buck chopper Calculated parameter like duty ratio, (Lmin), (Cmin).

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Table 2.4 Calculated Parameter for Buck Chopper

Pulse-width modulation (PWM) or pulse-duration modulation (PDM) or pulse-length modulation (PLM) is any encoding of a signal as a rectangular waveform with a time-varying duty cycle (and for some techniques, a time-varying period as well).

PWM is useful where the average power or amplitude produced by an electric signal needs to be controlled. The average current (and voltage) delivered to the load is controlled by switching the supply between 0 and 100% at a frequency higher than the time it takes to significantly alter the load. The longer the switch is in the on position, the more total amount of power delivered to the load. Other than maximum power point tracking, it is one of the fundamental ways of controlling solar panel output to what a battery can handle.[2] PWM is well suited to power inertial loads like motors, which are less easily disturbed by this switch discretely. The goal of PWM is to control a load; however, the PWM switching frequency must be well selected to smoothly do it.

The very low power loss of PWM in switching devices is its main advantage. Almost no voltage drop happens across a switch when electricity is being transmitted to the load, and almost no current passes through a switch when it is off. Given that power loss results from the interaction of voltage and current, it is negligible in both cases. Digital controllers can simply establish the required duty cycle as they serve as on/off. These controllers are additionally supported by PWM. In certain communication systems, PWM was been used to transmit data over a communications channel by utilizing its duty cycle.

**Duty Cycle**

The term duty cycle describes the proportion of 'on' time to the regular interval or 'period' of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, 100% being fully on. When a digital signal is on half of the time and off the other half of the time, the digital signal has a duty cycle of 50% and resembles a "square" wave. When a digital signal spends more time in the on state than the off state, it has a duty cycle of >50%. When a digital signal spends more time in the off state than the on state, it has a duty cycle of <50%. Here is a pictorial that illustrates these three scenarios:

A diagram of a cycle

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Fig 2.5 PWM Duty Cycles

**Single Pulse Width Modulation (SPWM)**

For every half cycle, there is only one pulse available to control the technique. The square wave signal will be for reference and a triangular wave will be the carrier. The gate pulse generated will be the result of the comparison of the carrier and the reference signals. Higher harmonics is the major drawback of this technique.

A diagram of a graph

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Fig 2.6 Sinusoidal Pulse Width Modulation.

**3.MATLAB Simulation**

**3.1. Introduction to Simulink and Implementation:**

Simulink is a visual programming interface used to construct an easy-to-use modelling system. It enables you to solve numerical equations using a graphical interface rather than code. A model's background contains blocks, signals, and annotations.

Blocks are used to depict math functions. It has a variable number of inputs and outputs:

• Signals or wires that connect and exchange values between blocks. Signals are not the same as knowledge.

* Types include numbers, vectors, and matrices. Signals can be recognised.
* Text and photos can be added to the model, but they are not used in computations.

• Other people can easily notice your model's style choices:

Simulink is a visual programming interface intended to make displaying frameworks natural. It offers an approach to settle conditions numerically utilizing a graphical UI, as opposed to requiring code. Models contain squares, sign and explanation on a foundation:

* Squares are numerical capacities; they can have changing quantities of sources of info and yields.
* Signals are lines interfacing squares, moving qualities between them. Signs are various information
* Types, for instance numbers, vectors or lattices. Sign can be named.
* Explanations of content or pictures can be added to the model, and keeping in mind that not utilized in the counts
* They can make it simpler for others to comprehend plan choices in the model.

**The Simulink Toolbar**

A screenshot of a computer

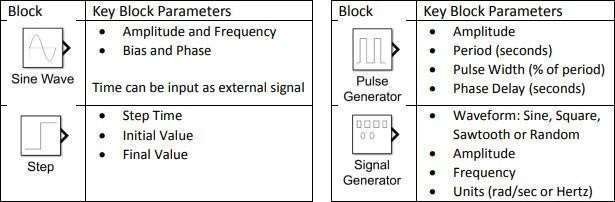
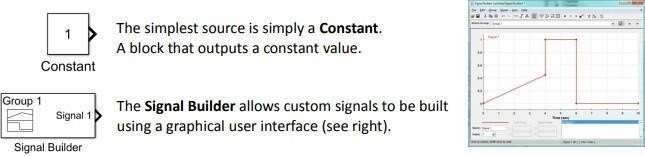
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**A table of text with black text

AI-generated content may be incorrect.i**. **Review of Libraries**

Table 3.1 Library names

**ii. Sources Library**



For progressively common occasional capacities, see the table underneath with key squares from this library.

**A screenshot of a computer

AI-generated content may be incorrect.iii. Sinks Library**

The squares in this library are generally utilized for reviewing information from the model.

**(a) Scope**

During simulation, view signals are created. A scope block displays its input as well as the simulation time. Each port has its own axis on the oscilloscope block. All axes follow the typical trajectory of the freelancing Y-axis over time. This area allows you to adjust the duration and variation of the displayed input value. Move and resize the oscilloscope window and change oscilloscope parameter values throughout the simulation.

Fig 3.1 Scope

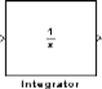
**(b) Continuous Integrator Library**

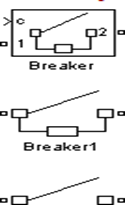
Fig 3.2 Integrator

The Integrator block returns the required input at the current time step. The initial state of block y as a characteristic of entry u is y0.

Where y and u are vector characteristics at time t of simulation.

(**c) Breaker**

Install a circuit breaker that opens while the contemporary goes to zero.

 Fig 3.3 Breaker

The firing of the circuit breaker block can be enabled through Internal Control mode or by a external SIMULINK control signal in the External Control mode. Therefore, a Rs-Cs snubber circuit is connected in series with fuse in this context. Whenever the block operates in series with a power circuit, an inductive circuit, or a power source, a snubber is required. When in the external management mode, the circuit breaker block will look like SIMULINK input icon. The control signal must be assigned as follows; For SIMULINK input trigger signal for zero mustbe0or1.   
Zero triggers the circuit breaker on while one trigger the circuit interrupter off. The mechanism of switching time is initiated when control mode is applied to the control panel of the circuit interrupter block. When the circuit interrupter is closed a block pulls. In comparison to other parameters, the Boccos value is reduced to the bare minimum need to be negligible **[**usually 10 m**]**. There is an endless amount of resistance when the breaker trips.

**(d) Features**

Function declared in the input Library:

Scientific operation

Fig 3.4 Features

The Trigonometric Function block's goal is to perform common trigonometric functions.

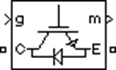
**(e) IGBT/Diode**

Fig 3.5 IGBT/Diode

A simpler IGBT (or GTO or MOSFET)/diode pair that removes forced commutation components and diode forward voltage is an IGBT/diode block.

An insulated-gate bipolar transistor (IGBT) is a three-terminal power semiconductor device primarily used as an electronic switch, which, as it was developed, came to combine high efficiency and fast switching. It consists of four alternating layers (P–N–P–N) that are controlled by a metal– oxide–semiconductor (MOS) gate structure.

Although the structure of the IGBT is topologically the same as a thyristor with a "MOS" gate (MOS-gate thyristor), the thyristor action is completely suppressed, and only the transistor action is permitted in the entire device operation range. It is used in switching power supplies in high- power applications: variable-frequency drives (VFDs), electric cars, trains, variable-speed refrigerators, lamp ballasts, arc-welding machines, and air conditioners.

**(f) Proceed with the description**

The Goto block routes input to the appropriate from blocks. As input, a signal with real or complex values, or a vector with any data type, can be utilized. The From and Goto blocks can be used to move a signal from one block to another without joining them.

A Goto block can send its input signal to multiple from blocks at the same time, but a from block can only receive one signal from a Goto block. The input to the Goto block is transferred to the from blocks associated with it as though the blocks were physically connected. For limits on using the from and Goto blocks, see from. The Goto tags in the Tag parameter are used to match Goto blocks and from blocks.

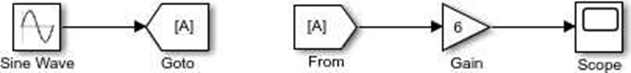
**(g) From the block**

A black and white logo

AI-generated content may be incorrect.A signal is received and produced by the from block from a matched Goto block. The output is of the same data type as the input to the Goto block. The From and Goto blocks can be used to send a signal from one block to another without joining them.

al is received and produced by the From block from a matched Goto block. The output is of the same data type as the input to the Goto block. The From and Goto blocks can be used to move a signal from one block to another without joining them.

In this paradigm, for example, a Goto and a from block are utilized.

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**iv. Math Operations Library**

A group of symbols with black text

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Fig. 3.6 Operations

The squares in this library identify with regular numerical capacities.

Include, Subtract and Sum Blocks the Add, Subtract and Sum squares are all basically the equivalent. By changing the Icon shape and List of signs in the square parameter you can change over one into the other (see right).

The output line voltage (Vbc) waveforms of the grid integrated system with SPWM, THIPWM, and SVPWM techniques for inverter control are shown in Figs. The output line voltage waveform with SPWM technique shows the most distortion in the waveform while the output line voltage waveform with SVPWM technique shows least distortion in the waveform.

Since, it is designed to turn on and off rapidly, the IGBT can synthesize complex waveforms with pulse-width modulation and low-pass filters, so it is also used in switching amplifiers in sound systems and industrial control systems. In switching applications modern devices feature pulse repetition rates well into the ultrasonic-range frequencies, which are at least ten times higher than audio frequencies handled by the device when used as an analog audio amplifier. As of 2010, the IGBT is the second most widely used power transistor, after the power MOSFET

A diagram of a battery

AI-generated content may be incorrect.The MATLAB simulation circuit of the system is shown in figure 3. In which subsystem of rectifier, inverter, wireless charging coils, and buck chopper mentioned. Also, PI controller is used for maintain the current constant.

Fig. 3.7 MATLAB Circuit

Subsystem of rectifier is shown in figure. In which four diodes are connected in a such a way that it forms a bridge rectifier. And for filtering purpose capacitor is used.

A diagram of a circuit

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Fig. 3.8 Rectifier Subsystem

Below figure 3.9 contains the inverter subsystem which has four MOSFETs. At the gate terminal of MOSFET, firing pulses are provided by a pulse generator.

A diagram of a block diagram

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Fig. 3.9 Inverter Subsystem

Figure 3.10 contains a subsystem of wireless charging coils. in which the transmitting coil and receiving coil are used for wireless power transfer. The mutual inductance block used as a transmitting and receiving coil. Which is available in MATLAB Simulink. A compensating capacitor is used to prevent the leakage flux.

A diagram of a capacitor

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Fig. 3.10 Transmitting and receiving coil

Figure 3.11 contain BUCK-chopper which contains MOSFET, inductor diode, capacitor, and resistor. Here PWM (DC-DC) generator is used as for gate pulse to the MOSFET. And diode is used as a freewheeling diode.

A diagram of a circuit

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Fig. 3.11Subsystem of Buck Chopper

Subsystem of PI controller for constant current method is shown in fig. In which charging current of battery is taken as feedback and compare with reference value of current. And then whatever difference from reference value and measured value of current is given into the PI controller. And output of PI controller will change the gating pulse of MOSFET in buck chopper.

Voltage at the secondary coil is 127.0V. Primary coil voltage is 230V and secondary coil voltage is 123.5V. So here drop of voltage is occurred in the resistance of coil. And also, voltage is drop down due to snubber resistance of diode.

A screenshot of a computer

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Fig. 3.12 Output Voltage and current at Receiving Side of Coil.

Output voltage at rectifier without buck chopper is shown in fig.3.13. In which it contains ripple means no smooth performance. Voltage of rectifier is initially increase and after some time it is constant 123.5V.

A graph with a line graph

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Fig. 3.13 Output Voltage and current at Rectifier Side.

Output voltage with buck chopper is shown in fig.3.14. Which shows a and voltage is reduced to 48V for our application. And voltage is smooth compared to the previous fig.

A graph with numbers and a yellow line

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Fig. 3.14. Output Voltage with Buck Chopper

Battery state of charge, charging current, and voltage are shown in fig.3.15. Battery state of charge is increase from 79.32% to 79.4%. And charging current is negative and constant 5A. As state of charge increases current is constant. And battery charging voltage is 48V. Initially charging voltage is increases and then after some time it is constant at 48V. Here battery charging is done with constant current method.

A screen shot of a computer

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A screen shot of a graph

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Fig. 3.15. Battery SOC, Current, Voltage

**4.Conclusion**

This work examines the charging of EV batteries using the inductive coupling method which is a technique used for WPT. Important variable under considerations involves rectifier output, receiving coil voltage and efficiency of battery charging.

In practice, the charging process always follows the cc (constant current) model in the process of charging Li-ion batteries. In this manner, it helps control energy flow hence absorbing stress associated with batteries and improves on efficiency. Based on simulation result, the battery SOC changes 0.08% within 40 seconds and SOC rises from 79.32% to 79.40%.

These findings show how through inductive WPT systems, EV charging may be made reliable. The work provides a way of improving on the current EV charging technology for future applications by incorporating wireless technology coupled with delivering the current as it is needed

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