SMPS and MOSFET Based Voltage Adjustable Float Cum Boost Battery Charger

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***Abstract*—This project explores the design andimplementation of a high-efficiency Switch-Mode Power Supply (SMPS) based battery charger utilizing MOSFETs as switching elements. The charger is designed to operate from a single-phase AC input and provide a regulated DC output voltage of 48V with an adjustable range of ±10V to cater to various battery requirements. Furthermore, it incorporates a float-cum-boost charging mechanism, enabling both maintenance charging of a fully charged battery (float mode) and rapid charging of a discharged battery (boost mode). The design will focus on achieving high power conversion efficiency, compact size, and reliable operation, incorporating essential protection features such as over-voltage, over-current, and short-circuit protection to ensure battery and system safety.**

***IndexTerms*—SMPS,MOSFET,thyristor,variac**

I. INTRODUCTION

A Switched-Mode Power Supply (SMPS) is an electronic power supply that incorporates a switching regulator to efficiently convert electrical power. Unlike linear power supplies that dissipate unwanted power as heat, SMPS devices switch the current to achieve the desired output voltages and currents, leading to significantly higher efficiency and smaller form factors. MOSFETs (Metal-Oxide-Semiconductor Field-Effect Transistors) are crucial semiconductor devices used as switching elements within SMPS topologies due to their fastswitching speeds, low on-resistance, and ability to handle significant current and voltage levels.In the context of battery charging, a specialized type of SMPS known as a "Float Cum Boost" charger is employed to ensure optimal battery health and availability. These chargers are supplies (UPS), and emergency lighting systems.

The "float" mode maintains the battery at its fully charged state by supplying a small current equal to its self-discharge rate, preventing overcharging while keeping it ready for immediate use.

The "boost" mode, on the other hand, is activated when the battery voltage drops below a certain threshold, indicating a discharge. In this mode, the charger delivers a higher current to rapidly replenish the battery's charge. Once the battery reaches its fully charged voltage, the charger automatically transitions back to the float mode. This dual-mode operation ensures that the battery is always optimally charged, extending its lifespan and guaranteeing power availability when needed.

The incorporation of MOSFETs in these chargers contributes to their efficiency and reliability. Their rapid switching capability allows for high-frequency operation of the SMPS, leading to smaller and lighter magnetic components (transformers and inductors) and filter capacitors. The low on-resistance of MOSFETs minimizes power loss during the switching process, further enhancing the overall efficiency of the charger.

The "voltage adjustable" feature adds another layer of versatility to these battery chargers. Different battery types and configurations require specific charging voltages to ensure proper charging and prevent damage. The abilityto adjust the output voltage allows the charger to be tailored to the specific requirements of the connected battery bank, accommodating variations in the number of cells or the electrochemical characteristics ofthe battery. This adjustability is often achievedthrough feedback control mechanisms within the SMPS, where the output voltage is continuously monitored and adjusted by controlling the switching duty cycle of the MOSFET.

A single-phase input SMPS based float cum boost battery charger typically draws power from a standard AC mains supply. This AC voltn rectified and filtered to produce a DC voltage, which is subsequently switched by the MOSFETs at a high frequency under

the control of a pulse-width modulation (PWM) controller. Theswitched voltage is then passed through a transformer (for isolation and voltage scaling), rectified, and filtered again to produce the desired DC output voltage for charging the battery.

The output of such a charger is specified as "DC 48V plus or minus 10V based voltage adjustable." This indicates that the nominal output voltage for the battery is 48V DC, and the charger can be adjusted within a range of ±10V around this nominal value (i.e., from 38V to 58V) to suit different battery configurations or charging requirements. This adjustable range accommodates variations in battery cell numbers or specific charging profiles recommended by battery manufacturers.

In summary, a single-phase input, MOSFET-based, voltage-adjustable float cum boost battery charger is a sophisticated power electronic device designed to efficiently and reliably charge and maintain a 48V DC battery bank. By leveraging the switching capabilities of MOSFETs and employing intelligent control strategies for float and boost charging modes, along with voltage adjustability, these chargers ensure optimal battery performance, extended lifespan, and dependable backup power for critical applications. The circuit diagram for such a system would illustrate the various power conversion stages, the MOSFET switching network, the control and feedback circuitry, and the necessary protection mechanisms to ensure safe and efficient operation.

II. LITERATURE SURVEY

[1] H Jagtap, Desai SG and Holmukhe RM, "Development and Performance Examination of Switch Mode Power Supply based Battery Charger for Electric Vehicle", Indian Journal of Science and Technology This study investigates the development and rigorous performance assessment of a switch-mode power supply (SMPS) based battery charger intended for electric vehicles. The project involves designing and building a charger utilizing a chosen SMPS topology, optimized for efficiency and the specific demands of EV batteries. The performance examination will include detailed measurements and analysis of key metrics such as charging efficiency, power quality (including power factor and harmonic distortion), output stability, and thermal behavior under various load and environmental conditions relevant to EV usage in regions like Coimbatore. The results will demonstrate the charger's effectiveness and identify potential areas for improvement in the context of local EV charging requirements and standards.

[2] I.A. Kazarinov, V.G. Duving, and Burashnikova M., Reshetov V.A, Borshchenko A.A, Shishova M.A., "Device for charging sulfated lead acid battery with pulse asymmetric current", Electrochemical power engineering, JSC "elektroistochnik", Saratov, Russia,. T. 11, No. 4, pp. 200-205, 2011. This work presents the development and evaluation of a novel charging device designed to rejuvenate sulfated lead-acid batteries using a pulse asymmetric current technique. The core principle involves applying controlled bursts of charging current interspersed with short, controlled discharge pulses to break down sulfate

crystals that impede battery performance. The device incorporates a power electronic converter capable of generating this specific current waveform, along with a control system to manage the pulse parameters. The effectiveness of this charging approach in restoring battery capacity and extending lifespan will be assessed through experimental studies, comparing its performance against conventional charging methods.

[3] A.G. Zdrok, Rectifier devices for voltage and charge stabilization of batteries, Moscow, Energoatomizdat, 1988, 144 p.

Rectifier devices play a vital role in battery systems by converting AC power to the DC power required for charging and maintaining batteries. These devices ensure that the battery receives a stable and regulated voltage, preventing overcharging or undercharging, which can significantly impact battery lifespan and performance.Different rectifier topologies, such as half-wave, full-wave bridge, and controlled rectifiers (using thyristors or transistors), are employed based on the specific application requirements, including power levels and desired charging characteristics. [2] Advanced rectifier designs often incorporate voltage regulation and current limiting circuits to further enhance battery protection and optimize the charging process.

[4]Ankur Bhattacharjee, "Design and Comparative Study of Three Photovoltaic Battery Charge Control Algorithms in MATLAB/SIMULINK Environment", **International Journal of Advanced Computer Research (ISSN (print): 2249-7277 ISSN (online): 2277-7970) Vol. 2, Num. 3, Iss.5, pp.129-137, 2012**. This study, focusing on the modelling and simulation of a solar photovoltaic (PV) array for battery charging using Matlab-Simulink, likely involves the creation of a virtual representation of a PV system. This model would incorporate the electrical characteristics of solar panels and how they respond to varying sunlight and temperature conditions, factors highly relevant in Coimbatore. The research would then integrate this PV array model with models of a battery and a charge controller within the Simulink environment. The primary goal is to simulate the battery charging process powered by solar energy, allowing for the analysis of system performance under different environmental scenarios and load conditions. This approach enables the investigation of charging efficiency, battery state-of-charge management, and overall system optimization without the need for physical prototypes, providing valuable insights for the design and implementation of solar-powered battery charging solutions in the local context of Coimbatore.

II.EXISTING METHOD

[1] Existing methods for switch-mode power supply (SMPS) based battery chargers for electric vehicles commonly employ a two-stage conversion process. The first stage typically involves a Power Factor Correction (PFC) circuit to rectify the AC input voltage from the grid and shape the input current waveform to be in phase with the voltage, thereby improving power quality. This PFC stage often utilizes topologies like boost converters or bridgeless rectifiers. The second stage then employs a DC-DC converter, such as a buck, boost, buck-boost, or resonant converter, to provide the regulated DC voltage and current required for charging the EV battery according to a specific charging profile (e.g., Constant Current/Constant Voltage). Galvanic

isolation is often incorporated between these stages using a high-frequency transformer to ensure safety. Advanced control techniques are implemented in both stages to achieve high efficiency, regulate

the output precisely, and ensure safe charging operation with features like over-voltage, over-current, and thermal protection.

[2] A device designed for charging sulfated lead-acid batteries with pulse asymmetric current employs a method based on alternating short, high-amplitude charging current pulses with discharging current pulses, often at a frequency that is a multiple of the AC mains frequency (e.g., 50 Hz). This approach aims to break down the hard sulfate crystals that accumulate on the battery plates, thereby restoring the battery's capacity. Such devices have shown effectiveness in reviving deeply sulfated batteries and can also be used for the initial formation of lead-acid batteries.

[3]Rectifier devices play a crucial role in voltage and charge stabilization for batteries by converting AC power to DC power suitable for charging and maintaining the battery's voltage within safe limits. Existing methods often employ full-wave rectifier circuits, sometimes with filtering capacitors to smooth the DC output and reduce ripple. More advanced systems incorporate voltage regulators, which can be linear or switching types, to ensure a stable output voltage regardless of fluctuations in the AC input or the battery's state of charge. These regulators prevent overcharging and deep discharging, thereby extending the battery's lifespan and ensuring reliable operation of connected devices.

[4] Existing methods for photovoltaic battery charge control, often simulated and compared in environments like MATLAB/SIMULINK, typically revolve around three fundamental algorithmic approaches: On-Off control, Pulse Width Modulation (PWM) control, and Maximum Power Point Tracking (MPPT) integrated charge control. On-Off control is the simplest, directly connecting or disconnecting the PV array based on predefined voltage thresholds. PWM control regulates the charging current by varying the duty cycle of a switching element, offering more precise control over the charging process and preventing overcharging. MPPT algorithms, such as Perturb and Observe (P&O) or Incremental Conductance, dynamically adjust the operating point of the PV array to extract maximum power, and when integrated with charge control, ensure efficient energy transfer to the battery while also managing its voltage and current limits to prevent damage.Comparative studies often evaluate these algorithms based on charging efficiency, battery lifespan, system stability, and complexity of implementation under varying solar irradiation and load conditions.

III. BATTERY CHARGER

A battery charger is an electronic device designed to replenish the energy stored within a rechargeable battery by forcing an electric current through it. Essentially, it reverses the electrochemical process that occurs when a battery discharges. The sophistication of a battery charger can range from a simple device supplying a constant DC voltage or current to highly intelligent units that monitor battery conditions and adjust the charging process accordingly.

At its core, a battery charger takes electrical energy from a source, typically an AC mains outlet, and converts it into a form suitable for charging a specific type and voltage of battery. This conversion usually involves stepping down the AC voltage using a transformer, rectifying it from AC to DC using diodes or a bridge rectifier, and then smoothing the DC output using capacitors to reduce ripple.

More advanced chargers incorporate control circuitry to regulate the charging current and voltage. This is crucial for ensuring safe and efficient charging and preventing damage to the battery due to overcharging or excessive heat. These control systems can employ various techniques, from simple linear regulators to more efficient switch-mode power supplies (SMPS). SMPS-based chargers are becoming increasingly common due to their higher efficiency, smaller size, and lighter weight, making them particularly suitable for portable applications and electric vehicles, as you are studying in Coimbatore. The charging process itself is tailored to the specific chemistry of the battery (e.g., lead-acid, lithium-ion, nickel-metal hydride). Different battery types have unique voltage and current requirements, as well

as specific charging algorithms. For instance, lithium-ion batteries often employ a constant-current/constant-voltage (CC/CV) charging profile. In the CC phase, the charger delivers a constant current until the battery reaches a certain voltage, after which it switches to the CV phase, maintaining a constant voltage while the charging current gradually decreases as the battery becomes fully charged.

Modern intelligent battery chargers often include features such as:

Voltage and Current Sensing: To monitor the battery's state in real-time.Temperature

Monitoring: To prevent overheating, especially during fast charging.

Charge Termination Logic: To stop charging when the battery is full, preventing overcharge. This can be based on voltage levels, current drop-off, temperature changes, or a combination of these factors.

Battery Conditioning or Reconditioning: Some chargers offer modes to optimize battery health by performing controlled discharge and charge cycles, particularly useful for older battery technologies like nickel-cadmium.

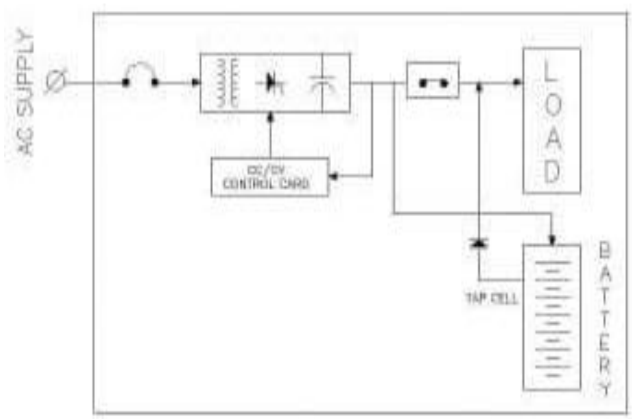
Multiple Charging Stages: Advanced chargers may employ several stages (e.g., bulk, absorption, float) to optimize

charging speed and ensure a full charge without damaging the battery.

Safety Features: Including reverse polarity protection, short-circuit protection, and over-temperature protection. In the context of electric vehicles, battery chargers are a critical component. They need to handle high voltages and currents and often incorporate sophisticated communication protocols with the vehicle's Battery Management System (BMS) to ensure safe and optimized charging. These chargers can be onboard, integrated within the vehicle, or offboard, as external charging stations. The development and performance examination of such SMPS-based battery chargers are vital for the widespread adoption and efficient operation of electric vehicles in regions like Coimbatore, where specific grid conditions and environmental factors may need to be considered.

IV. PROPOSED METHOD

A voltage-adjustable float-cum-boost battery charger employing a Switch-Mode Power Supply (SMPS) and MOSFETs offers an efficient and versatile solution for charging batteries. The SMPS topology enables compact design, high power conversion efficiency, and precise control over the charging process. Utilizing MOSFETs as switching elements allows for high-frequency operation, contributing to the SMPS's efficiency and enabling fast



and accurate current and voltage regulation. This type of charger typically incorporates two charging modes: a float mode to maintain the battery at its fully charged state by providing a small maintenance current and a boost mode to rapidly recharge a discharged battery by delivering a higher current and voltage. The voltage adjustability feature allows the charger to be adapted for different battery types and capacities, ensuring optimal charging and prolonging battery lifespan.

CIRCUIT DIARAM

A single-phase AC input would first be rectified and filtered to create a high-voltage DC bus. This DC voltage is then fed to a high-frequency switching stage, typically employing one or more MOSFETs. A control circuit, often a dedicated SMPS controller IC,

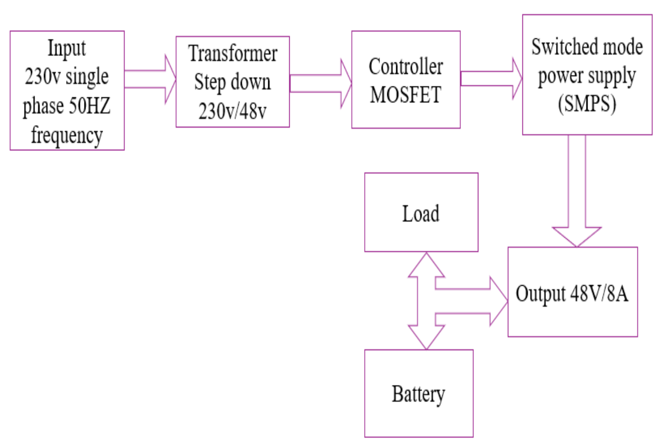
generates Pulse Width Modulation (PWM) signals to drive the MOSFET(s), switching them on and off at a high frequency. This

controlled switching action regulates the energy transferred to a transformer (often a flyback or forward topology for this power level and application), which provides isolation and steps down the voltage. The secondary side of the transformer has its own rectifier and filter to produce the desired adjustable DC output voltage around 48V. Feedback mechanisms are crucial; the output voltage is sensed and compared to a reference, and the control circuit adjusts the PWM duty cycle to maintain the desired output voltage, allowing for the ±10V adjustment. For the float-cum-boost functionality, the control circuit would implement different charging algorithms. In boost mode, it would typically deliver a controlled higher

current to rapidly charge a discharged battery. Once the battery reaches a certain voltage, it would transition to float mode, maintaining a lower, constant voltage to compensate for self-discharge and keep the battery fully charged without overcharging. Current sensing would also be integrated for over-current protection in both charging modes.

BLOCK DIAGRAM

This block diagram explain how the single phase AC input supply converted into DC output by using the SMPS and MOSFET the output connected to load and battery .



The system begins with a 230V single-phase 50Hz AC input, which is then stepped down to 230V/48V by a transformer. This lower voltage AC is fed into a controller that employs a MOSFI MOSFET, acting as a switching element, is controlled to ı the power delivered to the Switched Mode Power (SMPS). The SMPS then converts this controlled AC inpu DC output, capable of providing 48V at 8A.The output of the SMPS serves two primary purposes: to power the load and to charge the battery. The system is designed as a "float-cum-boost" charger, meaning it can maintain the battery at a float voltage when the load demand is low or absent, and it can provide a boost charge to quickly replenish the battery when it's discharged or when the load requires more power than the direct SMPS output can provide. The bidirectional arrows between the load and the battery, and between the SMPS output and both the load and battery, indicate this dynamic power flow and charging capability

operating temperature range, safety certifications, and any built-in protection mechanisms like over-voltage, over-current, and short-circuit protection. These specifications are crucial for determining if the S-1T85T is suitable for a particular application.

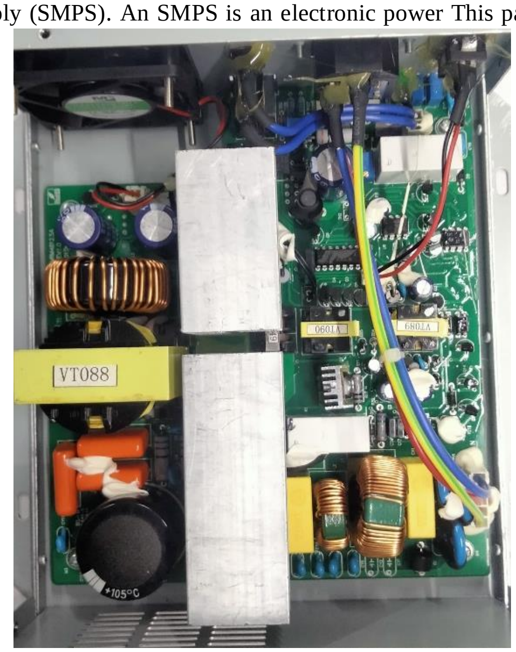
CIRCUIT DIAGRAM

Nowadays SMPS is taking place of transformer base power supply in every gadget. The main advantage of SMPS is it is very lightweight compared to the transformer. Here I am showing the schematic of 230V AC to 12V DC SMPS using MOSFET and two transistors. It is capable to supply up to 2A output current. Components count of this circuit is very low

VHARDWARE COMPONENT

SMPSS-1T85T

The "SMPS S-1T85T" refers to a specific model of a Switched-supply that efficiently converts electrical power using switching regulators. Unlike linear power supplies that dissipate unwanted power as heatSMPS devices rapidly switch current on and off to regulate the output voltage and current, leading to significantly higher energy efficiency, smaller size, and lighter weight. Mode Power Supply (SMPS). An SMPS is an electronic power This particular



model, the S-1T85T, will have its own specific technical specificationsTo understand this specific SMPS unit fully, it's essential to consult its datasheet. The datasheet would provide detailed informationabout its input and outputcharacteristics,suchas the exact AC input voltage range it can accept and the precise DC output voltage and maximum current it can deliver. It will also list the power supply's efficiency,

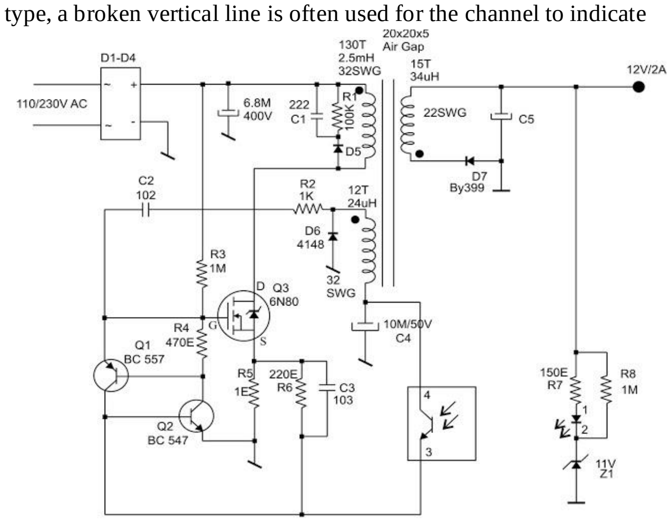
VI PARTS OF SMPS S-1T85T

MOSFET(IRFP460)

The IRFP460 is a robust N-channel power MOSFET, primarily utilized for high-voltage and high-speed switching applications. Manufactured by various companies like Vishay and STMicroelectronics, it's designed with a voltage rating of 500V and a continuous drain current of 20A, making it suitable for demanding power electronics. A key feature is its low on-state resistance, typically around 0.27 Ohms, which minimizes power loss and heat generation during operation, contributing to the device's efficiency and longevity. The IRFP460 also boasts a fast switching speed, a high input impedance, and the ability to handle rapid voltage changes, enhancing its versatility in various circuits.

SYMBOL

The schematic symbol for an N-channel enhancement-mode MOSFET like the IRFP460 typically shows three terminals: Gate (G), Drain (D), and Source (S). The Drain and Source are connected by a channel, represented by a vertical line. A third line, representing the Gate, is capacitively coupled to this channel and is drawn parallel to it but offset. For an N-channel enhancement type, a broken vertical line is often used for the channel to indicate



that no current flows between the Drain and Source when the Gate voltage is zero. An arrow is placed on the Source terminal, pointing inwards, to signify an N-channel device, indicating the direction of electron flow.

A diagram of the IRFP460 MOSFET, typically housed in a TO-247 package, would visually represent its physical form with three prominent leads extending from the package body. These

leads are labeled as Gate (G), Drain (D), and Source (S). The diagram would also clearly show the larger metallic tab with a mounting hole, designed for attachment to a heat sink to facilitate thermal dissipation, crucial for this power MOSFET's operation at higher current and voltage levels

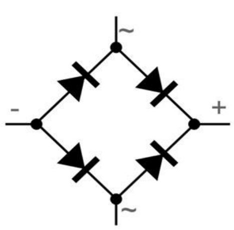
BRIDGE RECTIFIER

This describes a single-phase silicon bridge rectifier designed to convert alternating current (AC) into direct current (DC). The "single-phase" indicates it's intended for use with a standard single-phase AC power supply. The core component is a "bridge rectifier," which is an arrangement of four silicon diodes. Silicon is the semiconductor material used in the diodes, known for its reliable performance and ability to handle higher temperatures. This

The "voltage range of 50 to 1000 Volts" signifies the range of peak inverse voltage (PIV) that the diodes within the bridge can safely withstand without breaking down. This is a crucial parameter for selecting a rectifier suitable for a given AC voltage supply. The "current of 8.0 Ampere" indicates the maximum continuous forward current that the rectifier can handle without exceeding its thermal limits. Operating beyond these voltage or current ratings can lead to device failure

SYMBOL

The schematic symbol for an RS801 THRU RS807 bridge rectifier typically consists of four diodes arranged in a diamond or square configuration, representing the full-wave bridge circuit. Two diodes are oriented to allow current flow in one direction, while the other two are oriented to allow current flow in the opposite direction. The AC input is connected to the junctions between pairs of diodes, and the DC output (positive and negative terminals) is taken from the remaining two junctions. This arrangement ensures that current flows through the load in the same direction regardless of the polarity of the AC input.



TO-247 AD DIODE FORWARD CURRENT CURVE

The forward current curve of a TO-247 AD diode illustrates the relationship between the voltage applied across the diode in the forward direction (anode positive relative to the cathode) and the resulting current that flows through it. Typically, this curve starts with a region of very low current until a certain voltage threshold, known as the forward voltage(VF), is reached. Beyond this threshold, the current increases exponentially with increasing

current curve will characterize its ability to conduct significant current.with a relatively small increase in forward voltage beyond VF, forward voltage. For silicon-based diodes, this forward voltage

is typically around 0.6 to 0.7 volts. The TO-247 AD package is

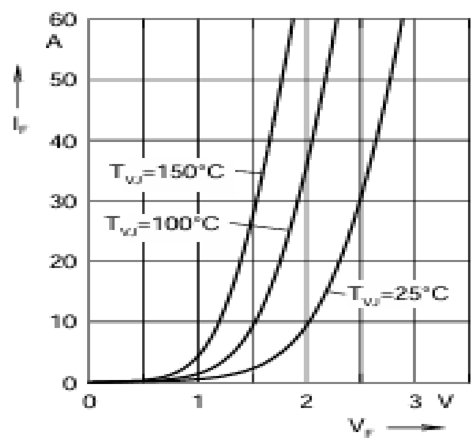


Fig. 1 Forward current I_F versus V_F

designed for higher power applications, so its forwardwhile also indicating the maximum forward current the device can handle without damage, often under specific temperature conditions

RECOVERY CHARGE CURRENT

The reverse recovery charge current curve of a TO-247 AD diode illustrates the behavior of the diode's current as it transitions from conducting in the forward direction to blocking voltage in the reverse direction. When the forward current is abruptly switched off, the current doesn't immediately drop to zero. Instead, a reverse current flows for a short period as the minority charge carriers stored in the diode's junction are swept out. This reverse current quickly rises to a peak value (IRRM) and then decays back to zero. The area under this reverse current-time curve represents the reverse recovery charge (Qrr), which is a measure of the stored charge that needs to be removed to turn off the diode completely. The shape and duration of this curve, along with the magnitude of IRRM and Qrr, are critical parameters that determine the diode's

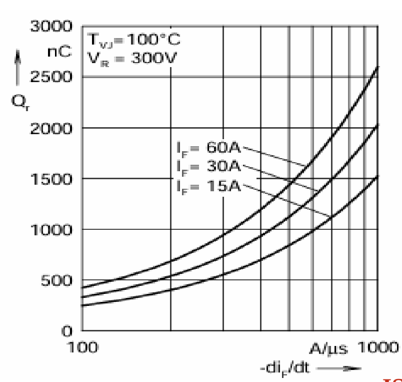


Fig. 2 Reverse recovery charge Q_r versus $-di_F/dt$

switching performance and the associated power losses in high-frequency applications.

Energy Storage Components:

Capacitors: Electrolytic capacitors are used to filter the input and output DC voltages, reducing ripple. Smaller ceramic capacitors are used for high-frequency filtering and decoupling.

Control Circuitry: An integrated circuit (IC) or discrete components form the control circuit. This circuit is responsible for: Generating thepulse-width modulation (PWM) signal that drives the MOSFET(s), regulating the output voltage and current.Providing feedback from the output to maintain a stable voltage under varying load conditions.Implementing protection features such as over-voltage protection (OVP), over-current protection (OCP), and sometimes over-temperature protection (OTP).

Optocoupler: Often used to provide galvanic isolation between the primary (input) and secondary (output) sides for safety and to allow feedback signals to cross the isolation barrier.

Resistors: Used for current sensing, voltage division in feedback networks, and pull-up/pull-down functions for ICs and transistors.

Input Filtering:Components like inductors, capacitors, and sometimes a common-mode choke are used at the input to filter out noise from the AC line and prevent noise generated by the SMPS from going back onto the line.

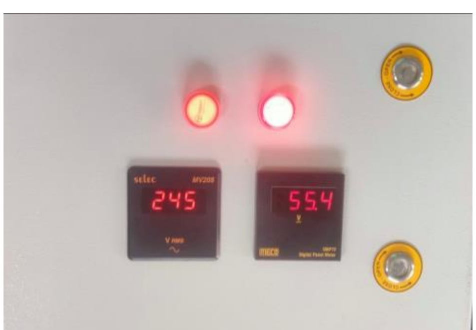
Protection Components: Fuses are typically included for overcurrent protection at the input. Varistors (MOVs) might be used to protect against voltage surges.

Printed Circuit Board (PCB): All the components are mounted and interconnected on a PCB.

Enclosure: A casing to protect the internal components and provide mounting.

LED INDICATOR

An AC 230V voltage indicator is designed to visually signal the presence of the standard mains electricity supply used in many parts of the world. These indicators often employ a neon lamp or an LED in series with a current-limiting resistor. When connected across a 230V AC source, a small current flows through the resistor and the indicator lamp, causing it to illuminate. The resistor is crucial to limit the current to a safe level for the indicator and prevent damage. These indicators are commonly found built into power sockets, extension cords, and electrical panels, providing a quick visual confirmation that the circuit is live.



A DC 48V voltage indicator serves a similar purpose but for direct current systems operating at 48 volts. These are frequently used in telecommunications equipment, some industrial control systems, and battery banks. A typical DC voltage indicator for this range would use an LED with a series resistor chosen to limit the current appropriately for a 48V DC input. The LED will light up when the 48V DC supply is present and correctly connected with the right polarity (for a simple LED indicator). More sophisticated DC voltage indicators might include polarity protection to prevent damage if the voltage is connected in reverse. These indicators help in troubleshooting and confirming the power status of DC circuits.

ELECTRICAL ENCLOSURE CABINET

An electrical enclosure cabinet constructed from 2mm thick MS CRCA (Mild Steel Cold Rolled Close Annealed) sheet steel is designed to house components such as SMPS (Switched-Mode Power Supply) and MOSFET-based voltage-adjustable float cum boost battery chargers. This material choice offers a balance between strength, cost-effectiveness, and ease of fabrication. The 2mm thickness provides sufficient rigidity to support heavy components and withstand mechanical stresses encountered during operation and transportation. The CRCA steel undergoes a cold rolling process, enhancing its surface finish and dimensional accuracy, which is crucial for precise assembly and alignment of internal components.

The enclosure is typically designed as a freestanding, floor-mounted structure with a double-door configuration, facilitating easy access for maintenance and operation. It includes features like ventilation louvers, cable entry points, and provisions for mounting various electrical components such as circuit breakers, meters, and control switches. To protect against environmental factors and corrosion, the steel surfaces are treated with a seven-tank process followed by epoxy powder coating, ensuring durability and longevity. The design also incorporates safety features like lockable doors, grounding provisions, and compliance with IP42 or higher ingress protection standards, safeguarding the internal electronics from dust and moisture ingress

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VII SYSTEM INTEGRATION

The SMPS and MOSFET-based float cum boost battery charger is a modern, high-efficiency charging system used primarily in industrial, power utility, and telecom applications. It uses Switch Mode Power Supply (SMPS) technology for energy efficiency and MOSFET-based voltage regulation for precision in output control.

VIII PURPOSE AND BENEFITS

To charge and maintain lead-acid or lithium-ion batteries by alternating between float and boost modes.

Float Mode: Maintains a small current to keep batteries topped up.

Boost Mode: Supplies a higher voltage for bulk charging or equalization.

Adjustable Voltage Output allows compatibility with various battery ratings and chemistries. Compact design and thermal efficiency due to SMPS topology.

Input & Protection System

AC Mains Input: Typically accepts 230V or 415V AC.

Circuit Breakers/Fuses: Protect against overcurrent conditions.

EMI/RFI Filters: Reduce electrical noise and ensure EMC compliance.

Surge Protectors: Guard the system against voltage spikes or lightning surges.

SMPS Power Conversion Block

High-frequency Transformer (e.g., VT088 in the image):Converts AC to high-frequency AC and then rectifies it to DC.

Rectifier & Filter Stage: Converts high-frequency AC to DC using diodes and capacitors.

Pulse Width Modulation (PWM) Controller: Regulates switching MOSFETs for precise voltage and current control.

MOSFET-Based Voltage Regulation

Power MOSFETs switch the output voltage between float and boost levels.Gate control is managed by a microcontroller or analog control circuit.Heatsinks and Thermal Sensors: Ensure temperature stability and avoid overheating.Provides fast switching and accurate control with high reliability.

Front Panel Interface

AC Voltmeter and DC Voltmeter: Indicate input and output voltages.

Push Buttons: For turning ON/OFF, mode selection, and reset.

LED Indicators: Indicate charging status – float, boost, fault, and power ON.

Banana Sockets (Yellow): For connecting test probes or load terminals.

Terminal Blocks and Wiring

Neatly arranged terminals for battery and control signal connections.DIN rail mounted terminal blocks for AC input, output DC, and ground connections. Internal busbars and cable lugs ensure mechanical strength and electrical safety. Integration Process, Testing & Applications

IX APPLICATIONS

Power Grid Substations

Telecom Towers

UPS Systems

Railways and Industrial Battery Banks

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